SCIENCE ABSTRACTS.

Section A.—PHYSICS.

AUGUST 1906.

GENERAL PHYSICS.

1333. *Machine for Compounding Sine Curves.* **W. G. Cady.** (Science, 23. pp. 877–881, June 8, 1906. Paper read before the Amer. Phys. Soc., Feb. 24, 1906.)—The machine described is designed for class use, and is different from such machines as Mach's or Michelson's harmonic analyser in that it can only be used to give the resultant of a fundamental sine curve and either its second, third or fifth harmonic. It can be quickly adjusted to give any desired amplitude or phase relation. The machine is somewhat complicated in detail, and the sketches in the original paper should be consulted. A hard rubber disc A, 21 cm. in diam., mounted at the end of a horizontal shaft O, carries a smaller disc B, to which a short pin P is attached. P fits in a slot in a movable horizontal bar S, to which is rigidly attached a vertical rod R. The latter carries a pencil, and slides up and down inside a slotted tube, so that the pencil registers the vertical component of the motion of P. A large gear wheel mounted on the shaft O engages in a rack on the under edge of a vertical board to which a sheet of paper is fastened. When the shaft is turned by means of a crank, the board advances horizontally and the pencil traces a curve whose form depends on the setting of the discs A and B. By means of gearing the disc B can be made to rotate either 2, 3 or 5 times for each revolution of A, thus giving three harmonics. A. W.

1334. *Distortion of Cyclic Elastic Bodies.* **V. Volterra.** (N. Cimento, 11. pp. 144–161, March, 1906.)—The problem of the hollow cylinder having radial slot is considered in greater detail than in the previous paper [see Abstract No. 1674 (1905)]. It is shown that the bases of the solid may be maintained plane by a system of forces normal to the ends, which are then at their original distance apart. Also, the circle which separates the regions of compression from those of extension has a radius which is the arithmetic mean of the extreme radii of the cylinder. Observations made upon a caoutchouc cylinder confirm the results obtained mathematically. (Accad. Lincei, Atti, 15. pp. 519–525, May 20, 1906.)—The author calculates the distortion of a hollow cylinder in which a wedge-shaped cut is made in one side, the planes of the cut intersecting upon a radial line and being equally inclined to the generating lines of the cylinder. In an actual case of a rubber cylinder the sides of the cut are brought together and cemented. Photographs of the solid so treated are given. [See Abstract No. 2139 (1905).] S. G. S.

1335. *Stretching of Thin Wires.* **G. Ercolini.** (N. Cimento, 11. pp. 125–143, March, 1906.)—Continuing his experiments upon the torsion and stretching of copper wires [see Abstract No. 1175 (1906)], the author investigates the simultaneous effect of a constant stretching force and one sinusoidally applied. The apparatus previously employed is modified for this purpose, and the results of experiment are exhibited in curves. It is found that the effect varies with the commencing value of the sinusoidally applied load. While the residual, and still more the permanent deformation increases with the amplitude of the sinusoidal load (P), the constant load (π) increases the former and diminishes the latter. If π is small with respect to P, it produces smaller temporary deformation than when $\pi = 0$, and if large, a greater effect. Amongst other conclusions it may be noted that a permanent deformation produces a large hysteresis, *i.e.*, a limited range of perfect elasticity. S. G. S.

1336. *Vibrations of Steamers.* **S. Yokota.** (Physico-Mathematical Soc., Tokyo, Proc. 3. 5. pp. 91–102, May, 1906.)—The vertical vibrations, which have been studied the most, appear to be due chiefly to the unbalanced forces and couples of the engines and to be influenced but little by the propeller. Examination of structural data for a torpedo-boat destroyer shows that the vibration is composed of different modes which are roughly harmonics—as experimentally found by Yarrow—if the ship acts as a long free-free bar. The horizontal vibrations are not discussed. In connection with this paper Terada showed with a wood-block model of a torpedo-boat that its frequencies of vibration, both vertically and horizontally, are less when it is floating in water than when out of water. R. E. B.

1337. *Relation between Tensile and Compressive Strength.* **L. Bergfeld.** (Ann. d. Physik, 20. 2. pp. 407–422, June 1, 1906.)—The author arrives at somewhat complex formulæ for obtaining the tensile strength of the more or less plastic metals, from the compressive load and the alteration of dimensions of cylinders of the metal which such compression produces. The coefficient of friction between lead and the hardened steel pressure plates is taken as varying from 0·2 to 0·5—average 0·4. The results of experiments on pure lead, commercial lead, an alloy of the latter with 0·98 per cent. zinc, pure tin, pure zinc, cadmium, commercial aluminium, pure silver, pure copper, and nickel are given. The increase of tensile strength of cast lead under increasing compression was found to follow the relation $F = 360\,(1 - 0{\cdot}6989\,b/r)$, where F is the tensile strength (calculated), b the height and r the radius of end of specimen after loading. The effects of duration of loading, of the smoothness of the pressure-plates, and of the presence of a lubricant, were observed. F. R.

1338. *Flow of Concrete under Pressure.* **I. H. Woolson.** (Eng. News, 54. p. 459, Nov. 2, 1905.)—Steel tubes of wall-thickness ⅛ to ¼ in., 4 in. diam. and 12 in. long, were filled with crushed stone concrete and allowed to set. The thicker-walled tubes stood 150,000 lbs. compression load without injury except for a shortening of ¼ in.; the thinner tubes began to show deformation at 120,000 lbs., and were tested up to 150,000 lbs. Photographs of four cylinders are shown. In two cases the compression is 3¼ and 3⅛ in. respectively, the diam. increasing to about 5 in. On sawing the tube the concrete is found to have "flowed" like a plastic material and to have taken the exact shape of the distorted tube. Reference is made to F. D. Adams, who has shown that marble will flow in this way (Amer. Geolog. Soc., 1901). L. H. W.

1339. *Calculation of Ferro-concrete Slabs.* **P. Caufourier.** (Génie Civil, 48. pp. 375–376, April 7, 1906. Engineering, 81. p. 736, June 1, 1906. Abstract.)—With the approximate assumptions (1) that the steel can be replaced by a material having the same coefficient of elasticity as the concrete, and of area equal to that of the steel × (E_s/E_c), the ratio of the coefficients for the steel and concrete (taken as 20), and (2) that the whole of the concrete in the tension side bears no tension : it is shown that $f_c = 2M/ax(\epsilon - x/3)$, and $f_s = M/\Omega(\epsilon - x/3)$, where f_c and f_s are the stresses in the concrete and steel respectively, M the bending moment, a the width, ϵ and x the depths of the axes of the steel bars, and the neutral axis respectively below the top of the slab, and Ω the area of the steel. Whence it is further shown that, designing normally so that the maximum working stresses in steel and concrete (taken as 1,000 and 50 kg. per sq. cm. respectively) are reached simultaneously, (1) the weight of steel, in kg. per sq. m. of slab, will be equal to ϵ in cm., and (2) the bending moment which a slab 1 m. wide can support $= 10\epsilon^2$ kg.-m. In English units these rules are : (1) Weight of steel in normal slab per sq. yard is 4·6*d* lbs. [misprinted 4·6 lbs.] where *d* is depth in inches of the steel work below top of slab ; (2) the safe bending moment for a slab 1 yard wide is $d^2/5$ ft.-tons. F. R.

1340. *Behaviour of Materials under Shear.* **E. G. Izod.** (Inst. Mech. Engin., Proc. 1. pp. 5–19 ; Discussion, pp. 19–55, Jan.–Feb., 1906. Engineering, 80. pp. 847–850, Dec. 22, 1905. Abstract. Bull. Soc. d'Encouragement, 108. pp. 131–135, Jan. 31, 1906.)—Special jaws are described, which were used for the tests, designed to prevent, as far as possible, yielding by bending. In a preliminary series practically identical results were obtained from mild steel bars notched in several ways, and from plain bars—the latter form was used in further experiments. Cast iron, wood, steels, and alloys were tested. The ratio of ultimate shear stress to ultimate tensile stress differs widely with different materials. When elongation is very little (as in cast iron), the ratio may be as high as 1·25, but in ductile materials, *e.g.*, mild steel, it is from 0·5 to 1·0. The shear stress for cast iron is somewhat high—average about 15 tons per sq. in., that for Swedish crucible steel increased regularly with carbon content, from 18·5 tons with 0·12 per cent. C, to 38·3 with 0·77 per cent. In the *discussion*, **J. H. Wicksteed** and others described a testing-machine shackle for single shear ; he gives a load-penetration diagram for shearing. **C. E. Stromeyer** discussed the effects of compound stresses upon steel. *Communications.*—**J. Goodman** gave a number of results which were closely in accord with the author's. The ratio of shear stress to maximum tensile stress ranged from 1·4 to 0·68 ; the ratio of shear stress to maximum tensile load divided by final area, from 1·36 to 0·44 ; the ratio of calculated shear stress at tensile fracture to experimental shear stress (Carus-Wilson's method) from 2·72 to 1. **W. C. Popplewell** had found $12T/\pi D^3$ to be the shear stress, sensibly uniform, in a torsion specimen at fracture ; T = torsional moment, D = diam. of bar. F. R.

1341. *Figures of Equilibrium of a Rotating Mass of Liquid.* **A. Liapounoff.** (Acad. Sci. St. Pétersbourg, Mém. 17. 3. pp. 1–32, 1905.)—Following the method given in a former memoir [see Abstract No. 3178 (1904)], the author puts the fundamental equation of the problem in a form which allows the unknown function expressing the potential of the liquid at any point to be investigated either by successive approximations or by series, and then presents this function in form of a series of powers of the excess of the angular velocity above that for the nearest ellipsoidal figure of equilibrium to the figure sought, these terms being such that in their evaluation the calculation can always be made. The approximation can thus be pushed to any extent desired. The convergence was also examined as in the former memoir, and the author claims that he has now rigorously established the existence of the figures of equilibrium which were given 22 years ago by calculations exact only to a first approximation. But his conclusions for figures that are deformations of the Jacobi ellipsoids are much less complete than for those which are deformations of the Maclaurin spheroids. He concludes, however, contrary to Darwin [Abstract No. 959 (1903)], that the pear-shaped figures of equilibrium are not stable, and gives reasons for thinking Darwin's analysis defective. R. E. B.

1342. *Figure and Stability of a Liquid Satellite.* **G. H. Darwin.** (Roy. Soc., Phil. Trans. 206. pp. 161–248, June 28, 1906. Proc. Ser. A. 77. pp. 422–425, May 14, 1906. Abstract. Nature, 74. pp. 115–116, May 31, 1906.) —Two problems are here considered—(1) the determination of the figures and secular stability of two masses of liquid revolving about one another in a circular orbit without relative motion of their parts, (2) the variation of the stability produced by solidification of one of the liquid masses without change of shape whereby tidal friction within it is removed. Ellipsoidal harmonic analysis is employed, the calculations being intricate and the numerical evaluations most laborious. In the first problem it is found that Roche's limit, *i.e.*, the distance (in planetary radii) between the centres of the satellite and the planet at which instability sets in, varies from 2·457 to 2·514 as λ, the ratio of their masses, changes from 0 to 1 [for values of λ from 0·5 to 1, at least, it seems to be $2{\cdot}454 + 0{\cdot}06\lambda$], the corresponding distances between their nearest points varying from 1·030 to 0·660 with a minimum of 0·638 for $\lambda = 0{\cdot}6$. For Roche's case, *i.e.*, for a spherical planet with infinitesimal planet, the limit is found to be 2·45539 instead of 2·44 (Roche's value determined graphically). For finite satellites the shape is an ellipsoid deformed by an infinite series of ellipsoidal harmonic deformations beginning with terms of the third order, the most important of which is due to the third zonal harmonic whereby the satellite assumes a somewhat pear-shaped figure, being sharpened towards the stalk end of the pear pointing towards the planet and blunted at the other end; and it is shown that, in every case of true limiting secular stability of the system, instability supervenes through tidal friction. The possibility of the development of the constriction between the stalk and the middle of the pear and of the pear breaking into two detached masses is studied, and it appears that two quasi-elliposids just detached from each other do not possess secular stability. Now Jeans finds [Abstract No. 958 (1903)] that the equilibrium of rotating liquid cylinders is quite analogous to that of ellipsoids, but the transition from a single rotating cylinder to two cylinders revolving about each other appears to be stable: hence at some stage the two problems, of the cylinders and ellipsoids, must part company, and Liapounoff [see preceding Abstract] would doubtless say at the beginning of the pear-shaped series. With this view and Liapounoff's general conclusion as to the instability of pear-shaped figures the author disagrees, but the final decision must await the publication of Liapounoff's paper in full. R. E. B.

1343. *Number of Corpuscles in an Atom.* **J. J. Thomson.** (Phil. Mag. 11. pp. 769–781, June, 1906.)—Three methods of determining the number of corpuscles in an atom are given, and from each it appears that this number is of the same order as the atomic weight. In the first method, the dispersion of a gas consisting of single atoms, or a diatomic gas in which the atoms have no resultant charge, is determined, the displacement of the negative corpuscles in one direction and of the positive sphere in the other by the oscillating electric field, and the resulting effect of this polarisation, being taken into account. If the mass of either the corpuscles or the positive sphere be zero, there will be no dispersion, for the configuration of the atom will depend only upon the instantaneous value of the electric field; but when the mass is not zero the rate of change of configuration depends upon the frequency of the field, and the gas will produce dispersion. From the expression for the refractive index obtained, and from Ketteler's values for the refractive index for hydrogen it appears that the number of corpuscles in the atom cannot be very different from unity and that the mass of the positive sphere cannot be small compared with that of the negative corpuscle or corpuscles. In the second method, the energy scattered per c.cm. of air when Röntgen rays pass through it is shown to be a constant fraction of the primary radiation, the fraction depending upon the number of corpuscles present per c.cm. and the mass of and charge upon each. From Barkla's determination of the fraction it is deduced that the number of corpuscles per molecule is 25, and since the scattering by air is very nearly the same as that by nitrogen, this again indicates that the number of corpuscles to the atom is very nearly the atomic weight. In the third method, the coefficient of absorption of β-rays is calculated, from which it again appears that the number of corpuscles to the atom is proportional to the atomic weight. If the number of corpuscles in the atom be as small as the above determinations indicate, a difficulty arises in explaining the large number of lines which exhibit the Zeeman-effect. Thus the number of lines in the case of the spectrum of iron is much greater than the atomic weight. The author considers, however, that the lines need not all be emitted by corpuscles within the normal atom, but that an atom in the flame or arc is surrounded by a swarm of corpuscles, and combinations are formed which last long enough to emit a considerable number of vibrations; lines produced in this way would not be reversed by the cold vapour, and the number of lines which show the Zeeman-effect reversed by cold vapour is in reality very small. S. G. S.

1344. *Viscosity of Mixtures of Argon and Helium.* **P. Tänzler.** (Deutsch. Phys. Gesell., Verh. 8. 12. pp. 222–235, June 30, 1906.)—The apparatus employed by Schultze [see Abstract No. 1616 (1901)] was used, and the viscosity measured by the method of transpiration at the temperatures 15°, 99·7°, 182·9° C. The viscosity increases with the percentage of helium in the mixture up to a maximum (quite 4 per cent. larger) for about 40 per cent. of helium, though for pure helium it is less than for pure argon by 11 per cent.; its values for temperatures from 0° to 183° C. can be expressed very well by Sutherland's formula, but the formula of Puluj can only be regarded as approximate, too large values being in general given by it for the higher proportions of helium. Thiesen's theory is confirmed by the observations, but the conditions for the existence of a diffusion-coefficient are not fulfilled. R. E. B.

1345. *Viscosity of Gaseous Mixtures.* **M. Thiesen.** (Deutsch. Phys. Gesell., Verh. 8. 12. pp. 236-238, June 30, 1906.)—Tänzler has deduced from his experiments [see preceding Abstract] that Sutherland's law as to temperature and Thiesen's law as to concentration are satisfied by the viscosity of a gaseous mixture. But these laws are incompatible. The author shows that his own law satisfies Sutherland's in the case of *pure* gases if put in the form $\eta = m_1\phi_1/(a_{11}\phi_1 + a_{12}\phi_2) + m_2\phi_2/(a_{21}\phi_1 + a_{22}\phi_2)$, where ϕ_1, ϕ_2 are the percentages by volume of the components, m_1, m_2 their molecular weights, and $a_{11} \equiv \alpha_{11}\tau + \beta_{11}\tau^3$, $a_{12} \equiv \alpha_{12}\tau + \beta_{12}\tau^3$, $a_{22} \equiv \alpha_{22}\tau + \beta_{22}\tau^3$, $a_{21} \equiv \alpha_{21}\tau + \beta_{21}\tau^3$, τ being put for the square root of the reciprocal of the absolute temperature and the other letters denoting constants. These latter may possibly be connected by the relations $a_{12}/a_{21} = \sqrt{(m_1/m_2)} = \beta_{21}/\beta_{12}$, which would reduce them to six. R. E. B.

1346. *Possible Relation between Radio-activity and Gravitation.* **G. Sagnac.** (Journ. de Physique, 5. pp. 455–462, July, 1906.)—It has been suggested that radio-active bodies borrow energy from the medium in which they are, and that the attraction on a radio-active atom is made up, not only of a part which would be unaltered if it were non-radio-active, but also of a part dependent on the medium. Under these circumstances the masses of equal weights of a radio-active and a non-radio-active substance would be unequal. This was tested by observing the oscillation periods of a short quartz rod, suspended by a quartz thread 4 cm. long, weighted at the ends by small glass tubes containing (1) 0·4 gm. of a sulphate of which about half is radium sulphate, (2) an equal weight of barium sulphate, the whole being in a bell-jar under an air pressure of 4 cm. of mercury. The observations showed that the masses of equal weights of pure barium and radium do not differ by 10 per cent. nor those of equal weights of pure barium sulphate and radium sulphate by 7 per cent. R. E. B.

1347. *Black Spot in Liquid Films.* **E. S. Johonnott, Jr.** (Phil. Mag. 11. pp. 746–753, June, 1906.)—It is found that sudden increase of pressure on a film is accompanied by rapid thinning of the film, a rapid thickening resulting from sudden decrease of pressure; these effects are obviously due to the adiabatic changes of temperature. By passing the light used with a Michelson interferometer through 221 films the measurements of the mean limiting thicknesses of the first and second black films given in a former paper [see Abstract No. 1338 (1899)] were confirmed, and it appears that a second black film may have a thickness 50 per cent. greater than the limiting thickness. Reinold and Rücker's observation of the apparent continuity of the surface tension in passing from one black film to another, though the change of thickness is discontinuous, is also confirmed. It further seems possible to distinguish five species of black films, of which the two considered above are the thinnest. An explanation of the discontinuity by consideration of James Thomson's form of isothermal is given. R. E. B.

1348. *Relation between Storm Movement and Pressure Distribution.* **E. H. Bowie.** (Monthly Weather Rev. 34. pp. 61–64, Feb., 1906.)—Where storms move in an easterly direction in middle latitudes, a storm centre lying near and south of an area of high pressure pursues a course that deviates to the right of the habitual track of normal storms for that locality. The converse holds for a storm centre lying N. or NW. of a high-pressure area. A high-pressure area covering the region towards which the storms would normally travel retards its progress; and a high-pressure area in its rear accelerates it. The velocity and direction of the storm movement could be predicted were it possible to obtain correct values (1) of the displacement of the storm centre arising from the unequal pressure distribution, and (2) of the drift of the upper air-currents which appear to carry the storm with them. Each tenth of an inch increase in barometric pressure, measured outwardly from the storm centre along lines radiating to the N., NE., E., &c., has, after many trials, been considered to be equivalent to a movement of the storm centre by 62·99 miles. By taking the general resultant of those eight vectors as one of the components which move the storm along its track, the other, the eastward drift, can be found. The author shows how this is done, and gives a table of his forecasts for Jan., 1903, which mark a very good agreement for the predicted velocity, and fairly good results for the direction of the storm movement, the actual path diverging on an average by 8° from the predicted. Cases of several ill-defined storm centres are difficult to deal with. H. B.

1349. *Thermodynamics of the Atmosphere.* II. *Co-ordination of the Velocity, Temperature, and Pressure in the Cyclones and Anticyclones of Europe and North America.* **F. H. Bigelow.** (Monthly Weather Rev. 34. pp. 74–78, Feb., 1906.)—It would be desirable to have in America, as in Europe, numerous simultaneous ascensions from different points of the same cyclone. But repeated ascensions at a single station, with special facilities for the work, accomplish the same purpose, by allowing the kites to remain aloft and thus permitting the cyclone to drift past the instrument. After escaping from the confusion in the circulation near the surface, about the same temperatures seem to prevail in the midst of the tracks of the cyclones and anticyclones over Blue Hill, lat. 42°, Berlin, lat. 52°, Hald, lat. 56°; the European data may, therefore, approximately be applied to the American temperatures above the 4,000-m. level. The author distinguishes as before [see Abstract No. 1187 (1906)] N., E., S., W. quadrants for the north temperate latitudes of the two continents. He finds that for the N. quadrant there is both for velocity components and for temperature variations a rotation through about 90°, from the NW. to the NE., in passing from the 10,000-m. levels to the surface, and that the rotation in the S. quadrant is less in the respective cases. The eastern drift gradually breaks up into gyrations in the lower levels; the anticyclone has a system of outward components from top to bottom, the cyclone a system of inward components from bottom to top, but there is no true inversion in either case. On descending the pressure takes the features of high and low pressure areas, the high areas standing with the "saddle" towards the S., the low areas with the "saddle" towards the N. The closed isobars decrease in density from the surface upward, and disappear 2 or 3 miles above ground. Where closed isobars occur there is a vertical component, upward in cyclones, downward in anticyclones; there is very little vertical movement in the upper levels. H. B.

1350. *Vertical Temperature Gradients on the West Coast of Scotland and at Oxshott, Surrey.* **W. H. Dines.** (Roy. Soc., Proc. Ser. A. 77. pp. 440–458, May 14, 1906.)—The results of the kite observations [see Abstract No. 2839 (1904)] consist of 16 traces at Crinan in August, 1903, 29 traces at Crinan (kite flown from H.M.S. *Seahorse*) in June and July, 1904, and 75 traces at Oxshott. Most of the Oxshott ascents were made on international days; the kite broke away 5 times, but the improved meteorograph was never lost nor damaged. At Crinan south-easterly (continental) winds were blowing in 1904 instead of the usual westerly winds, and these winds brought steeper temperature gradients (characteristic of continental winds) and also temperature inversions; on several dry days and also on one wet day the air on the top of Ben Nevis was warmer than at the corresponding height over the sea; after July 19 the barometer trace was almost a straight line, and the wind failed entirely at the height of a few thousand feet. The height of clouds is difficult to ascertain, as the kite may be only obscured by the clouds without being above them. The average temperature gradients per 100 m. for heights up to 500, 1,000, 1,500, 2,000, 2,500 m. were in 1904, at Crinan: 0·77, 0·53, 0·84, 0·49, 0·51° C., and at Oxshott, 0·77, 0·57, 0·87, 0·80° C. The gradient was small at Crinan for the first 500 m. in cyclonic weather, and low also for the range 1,000 to 1,500 m. with south-easterly winds. Temperature inversions go together, with a large decrease in relative humidity, and the warmth seems to be due to the compression of the descending air rather than to the presence of warm horizontal currents; each ascending air current that is accompanied by condensation of vapour should tend to form an inversion elsewhere. The vertical components of the air velocity are probably very small, a few hundred feet per hour. In one case a powerful convection current was distinctly observed, raising the kite from about 4,500 ft. (temperature 5° C.) to 5,800 ft. (temperature 9° C.) in 2¼ min.; the relative humidity rose from 90 to 100 per cent., the strain on the wire from 50 to 200 lbs.; the kite soon fell back again. H. B.

1351. *Local Winds in the Neighbourhood of the Canaries.* **H. Hergesell.** (Comptes Rendus, 142. pp. 1360–1363, June 11, 1906.)—The author gives further proofs that the sea-breeze from the SW. which he observed on and off the Canaries in 1904, during the morning hours, was a purely local wind due to the heating of the land; a land wind stronger than the sea-breeze followed after a calm in the afternoons. This land wind raised the temperature over the sea from 24° C. at 3 p.m. to 42° at 8 p.m., while the relative humidity decreased from 67 to 12 per cent.; the data agree with Hann's formula for the vertical temperature gradient. The author emphasises that Teisserenc de Bort and Rotch [see Abstracts Nos. 519 (1905) and 22 (1906)] have misunderstood him when stating that he denied the existence of the SW. counter-trade. His own observations and conclusions concern districts outside the trade-wind belt proper; as regards the Canaries, he differs from those observers. H. B.

1352. *Experiments on Seiches.* **P. White and W. Watson.** (Roy. Soc. Edinburgh, Proc. 26. pp. 142–156, 1905–1906.)—Seiches were artifically generated in water in a small rectangular trough by means of a square of wire gauze actuated by a pendulum, but really guided by the hand. The character of the lake-bed was varied by fitting differently shaped blocks of wood to the bottom of the trough, the beds experimented with being in elevation a concave symmetric parabola, a concave semi-parabola, a convex symmetric parabola, two symmetric straight lines, one straight line, a concave truncated quartic. In some cases the water could be made to oscillate in as many as five or seven modes. The agreement of the observations with Chrystal's formulæ [see Abstract No. 1698 (1905)] is most satisfactory, though for the seiches of high nodality with the concave parabola and quartic, the divergence between the theoretical and observed results increased with the nodality, and doubtless because in these cases the square of the ratio of the depth to the wave-length was not negligible as presupposed in the theory. The exact positions of the nodal lines were hard to fix, the observations only giving limits within which the nodes lie; compared with the nodes in a trough of uniform depth they are displaced towards the shallower parts of the water. A method of recording the separate motions of two superimposed seiches is given, and some interesting observations connected with the generation of seiches are described. [See also Abstract No. 256 (1906).] R. E. B.

1353. *Seismic Action and Geological Structure; the Kanamé-Ishi Rock of Kashima.* **S. Kusakabe.** (Physico-Mathematical Soc., Tokyo, Proc. 3. 4. pp. 88-90, May, 1906.)—The Kashima district, 50 miles NE. of Tokyo, suffers little from earthquakes, while the neighbourhood is often disturbed. Omori had ascribed this tranquillity to the shadow effect exerted by the big mass of the Kanamé-Ishi rock, whose outcrop lies in the centre of that district. In the author's opinion the district is in itself comparatively stable, and the surrounding regions are bad conductors for seismic waves. The etymology of the name Kashima suggests that the district was once an island in the Pacific. The shielding action is due, not to the presence of more elastic rocks between the region and the seismic centre, but to the presence of the non-elastic alluvial marshes and swamps in which the seismic energy is dissipated. H. B.

1354. *Connection between Different Eruptions and Earthquakes.* **H. V. Gill.** (Roy. Dublin Soc., Proc. 11. 11. pp. 107-110, June, 1906.)—A ball dropped into a hollow teetotum which is spinning evenly makes it wobble, but evenness in the spin returns if another equal ball or two equal balls are introduced; these balls are found to take up positions equally spaced around the circumference. The author suggests that when Vesuvius became active on April 8th, the displacement of material caused the earth to wobble, giving rise to stresses which resulted in the earthquake at Formosa on April 14, and that at San Francisco on April 18, these three places being in a narrow belt of mean latitude 34° N., and being separated in longitude by from 107° to 137°. R. E. B.

1355. *Distribution of Ultra-violet Light on Sun's Disc.* **K. Schwarzschild** and **W. Villiger.** (Astrophys. Journ. 23. pp. 284-305, May, 1906.)—The decrease of brightness from the centre to the edge on the sun's disc is investigated, dealing chiefly with the ultra-violet light down to λ3200. A special light-filter was made by coating a specimen of ultra-violet glass with a thin film of silver, the glass in this case being the objective itself. By means of preliminary exposures to the spectrum of iron it was found that the radiation transmitted only extended from λ3200-3250. The objective was 120 mm. aperture and 325 cm. focus. The variations were measured by means of sector diaphragms. The plates were then measured with a microphotometer against a photographic wedge. Extensive tables are given to show the results determined. The decrease of brightness is not more marked in the ultra-violet than in the violet; the gradual increase in the rate of falling off which is observed in passing from the red toward the violet, comes to a stop in the ultra-violet. It is noteworthy that, if true, this result is opposite in character to the absorption of the earth's atmosphere, which increases very rapidly towards the ultra-violet. [See also Abstract No. 71 (1906) and next Abstract.] C. P. B.

1356. *Ultra-violet Radiation of Sun-spots and Faculæ.* **K. Schwarzschild** and **W. Villiger.** (Astrophys. Journ. 23. pp. 345-346, May, 1906.)—After brief reference to the work of previous authors [Abstract No. 490 (1906)] on the radiation of sun-spots, the authors describe their recent researches on the ultra-violet radiation for wave-length 3200. In photographs taken in this special light it was noticed that the umbræ of the larger spots exhibited very greatly increased contrast. The brightnesses of the regions are then given in comparison with the brightness of an undisturbed place at equal distances from the centre. In the case of the faculæ, their brightness in no case exceeded by more than 20 or 30 per cent. that of the undisturbed neighbourhood. C. P. B.

1357. *Eclipse Shadow Bands.* **M. Roso de Luna.** (Astronom. Nachr. No. 4086. Nature, 74. p. 135, June 7, 1906. Abstract.)—The author proposes to employ six screens for observing the shadow bands preceding and following a total eclipse of the sun, one horizontal, two vertical (N. to S. and E. to W.), one oriented to the azimuth of the sun at totality, and another perpendicular to this direction, and one placed in the direction of the wind. This scheme was used during the eclipse of Aug. 30, 1905, in Spain, with the following results: Breadth of bands = 2 cm.; distance between consecutive bands = 6 cm.; velocity of translation = 30 m. per min. C. P. B.

1358. *Polarisation of the Sky during a Total Solar Eclipse.* **N. Piltschikoff.** (Comptes Rendus, 142. p. 1449, June 18, 1906.)—During the total phase of the eclipse of 1905, Aug. 30, the polarisation of the sky at a point 90° from the sun in a vertical plane was found to be zero. The explanation is that the photo-polarimeter placed in the shadow of the moon receives two kinds of luminous rays—first, polarised rays, due to illumination of the shadow cone by the corona; second, neutral rays, due to illumination of the earth's atmosphere, outside the shadow by sunlight. The polarisation of the first is masked by the second, which are of much the greater intensity. [See also Abstract No. 2150 (1905).] A. E.

1359. *New Method for Discovery of Asteroids.* **J. H. Metcalf.** (Astrophys. Journ. 23. pp. 306–311, May, 1906.)—In Max Wolf's method the camera is adjusted to stellar rate, thereby obtaining all the star images as minute points, while any asteroids happening to be passing through the region would impress themselves as short trails, the intensity of which would depend on the brightness of the asteroid. The limit to this method occurs when the trail is so faint that it cannot be measured. The present author has successfully overcome this difficulty by reversing the process; the photographic camera has its rate of movement adjusted to be equal to the computed velocity of the asteroids, and the surrounding stars come out as short trails of varying densities. Of course this scheme is subject to the uncertainty consequent on the velocity of the asteroids being unknown, but as these bodies all lie within certain limits in the solar system, their probable velocities may be approximately computed, at least sufficiently to greatly shorten their trail on the photographic plate. By these means the fainter asteroids can impress themselves by reason of the longer exposure, and photographs are given showing the images of asteroids of the 13th magnitude, which is much beyond the possibilities of the usual methods of detection.
C. P. B.

REFERENCES.

1360. *Molecular Changes in Nickel Steel.* **C. E. Stromeyer.** (Nature, 74. p. 223, July 5, 1906.)—A clock having an invar pendulum which was properly adjusted, was found, after the clock received a shock, to be going as though the pendulum were undercompensated, *i.e.*, the coefficient of expansion had increased. A case is also quoted of a change in the temperature error of a watch whose balance wheel was of invar and brass, after 2 years. L. H. W.

1361. *Influence of Surface Tension on the Speed of Waves Parallel to the Surface of a Liquid Lamina.* **Alliaume.** (Comptes Rendus, 143. pp. 30–32, July 2, 1906.)—Boussinesq gives, for the speed of propagation of waves of a liquid of depth H in a rectangular canal when the small change of level at section x and time t is h, the expression—

$$\surd(gH)[1 + 3h/4H + (H^2/6h)\partial^2 h/\partial x^2].$$

If the surface tension f is also taken into account, the last term has to be multiplied by the factor $1 - 3f/g\rho H^2$, where ρ is the density of the liquid. R. E. B.

1362. *Principle of Virtual Work in Relation to Friction.* **G. Almansi.** (Accad. Lincei, Atti, 15. pp. 539–544, May 20, 1906.)—The applicability of the principle of virtual work to displacements involving friction is discussed. The author concludes that "the necessary and sufficient condition for equilibrium for a system of bodies in contact, between whose surfaces there is friction, is that for any infinitesimal deformation compatible with given conditions the sum of the work due to external forces, to internal forces, and to friction shall be zero or negative." S. G. S.

1363. *Conservation of the Motion of the Mass-centre.* **A. Einstein.** (Ann. d. Physik, 20. 3. pp. 627–633, June 26, 1906.)—An illustration is given in which the ordinary mechanical laws are satisfied only if the assumption is made [see Abstract No. 133 (1906)] that a body's mass m is dependent on its energy-content e in such wise that $dm = de/c^2$, where c is the speed of light. The author now attempts to show, by assumption of the Maxwell-Lorenz equations, that this is the necessary and sufficient condition for the conservation of the motion of the mass-centre for systems wherein electromagnetic as well as mechanical processes are occurring. [But the mathematics are not unassailable.] R. E. B.

1364. *Electrical Conductivity of Sea-water.* **E. Ruppin.** (Zeitschr. Anorg. Chem. 49. 2. pp. 190–194, May 14, 1906. Laborat. für internat. Meeresforschung, Kiel.)—Values are given for the electrical conductivity at 0°, 15°, and 25° of sea-water containing 0·5 to 4 per cent. of salt. Observations of electrical conductivity can be used to determine the concentration of samples of sea-water; the values deduced are more accurate than those obtained from density observations with the hydrometer, but less accurate than those deduced from titrations. T. M. L.

1365. *Comparison of the Upsala and Göttingen Seismograms.* **F. Åkerblom.** (Gesell. Wiss. Göttingen, Nachr., Math.-Phys. Klasse, 1, pp. 121–123, 1906.)—In two cases the variations between these seismograms for the same earthquake indicate that the tremors have reached the observatories from opposite directions, so that they have travelled round the earth in reverse directions. R. E. B.

1366. *Photography of Solar Corona without Eclipse.* **G. Millochau** and **Stefanik.** (Comptes Rendus, 142. p. 945, April 23, 1906.)—The authors propose to combine the use of the spectroheliograph with certain specially prepared coloured screens in order to attempt the photography of the solar corona in ordinary daylight. The secondary slit of the spectroheliograph will be set on the green line 5303, which is characteristic of the coronal radiations. C. P. B.

LIGHT.

1367. *Dilatometer Principle for Projection.* **U. Behn.** (Deutsch. Phys. Gesell., Verh. 8. 12. pp. 205–208, June 30, 1906.)—The points of intersection of two sheaves of equidistant parallel lines I. and II. lie also on parallel lines III. equidistant from one another. If the lines I. and II. are dark strokes of appreciable thickness, then the lines III. will consist of bands of maximum brightness alternating with others of maximum darkness, and the position of these latter is well defined. If the angle ϕ between I. and II. varies, the distance apart l of the lines III. varies also. If ϕ is small then the variation of l is very large. If c is the distance apart of the lines I. or II., we have $\sin(\phi/2) = c/2l$, hence $dl/d\phi = -[l^2 \cos(\phi/2)]/c$ or $dl/d\phi = -l^2/c$. This can be used for the measurement of (say) small thicknesses. The author describes one form of apparatus for measuring the increase in length of a heated bar. One grid is fixed, and the other is turned about a knife-edge at a known distance from one end of the bar. The width between the dark bands, projected on to a screen, is then measured, and so from the above relation $d\phi$, and consequently the increase in length can be calculated.

A. W.

1368. *Extension of Doppler's Principle.* **A. Schmidt.** (Phys. Zeitschr. 7. pp. 323–329, May 1, 1906.)—The shortening or lengthening of the wave-length of the light received from a source has been shown by H. Poincaré to depend upon the motion of any body by which the light is reflected on its way from the source to the observer; further, W. Michelson has shown that the wave-length depends upon the rate at which the optical distance between source and receiver is changing, both on account of change in actual length of path and in refractive index of medium. Michelson's method was further developed by J. Fényi [see Abstract No. 1411 (1904)], but the author points out that Michelson's and Fényi's treatment is subject to a fundamental error. The reflected or transmitted beam is considered to consist of the beams reflected at succeeding instants superimposed upon each other; and this, according to the author is unjustifiable, as in the case of oblique incidence the beams do not overlap. The problem is then attacked by considering that the incident beam gives rise to a series of separate impulses at the surface of separation of the two media considered, and the transmitted or reflected beam is determined by finding the new wave-surface by the method of Huyghens. Thus the moving surface of separation behaves as a receiver to the incident beam and as an emitter to the refracted beam. If the normal to the moving surface of separation be rotated through the small angle ϕ, then the new law of refraction which applies in this case is found to be $\sin(i \pm \phi) = \mu \sin(r \pm \phi)$, the upper sign being taken in the case of refraction and the lower in the case of reflection, and ϕ an angle which depends on the velocity of the surface and that of light. The change in frequency produced by the motion is given by $n_1 = n_0\left(1 - \frac{c}{v \cos i}\right) \Big/ \left(1 - \frac{\mu c}{v \cos r}\right)$, where n_0 is the original frequency and n_1 that at the receiving station, c the velocity of the surface, and v that of light. The remainder of the paper is taken up with a discussion of the limits of applicability of this method and the application of it to the study of the condition of the outer layers of the sun. It is pointed out that the high velocities ascribed to the gases in the protuberances, calculated on the assumption of a simple Doppler-effect, are quite unnecessary, since the same displacement of the lines would be produced by the refraction of comparatively cold layers of gas moving with much smaller velocities.

S. G. S.

1369. *Demonstrating the Change in Light Velocity on passing from Air to another Medium.* **E. Grimsehl.** (Phys. Zeitschr. 7. pp. 472–475, July 1, 1906. Phys. Laborat. der Oberrealschule auf der Uhlenhorst, Hamburg, May 6, 1906.)—The distance between consecutive spectra produced in a given plane by a diffraction grating is proportional to the wave-length of light employed, and this for given frequency is inversely as the velocity of propagation. Hence the number of spectra falling within a given space varies inversely as the velocity. Thus, a diffraction grating is placed at one end of a long rectangular box and a semi-transparent screen at the other, and an image of a slit produced by a lens falls upon the screen, the light having passed through the grating. When the box is half filled with water the set of spectra falling on the upper half of the screen is more openly spaced than that on the lower. Approximately three spaces of the upper set coincide with four of the lower. Using a glass block instead of the trough, the numbers are 2 and 3. Since both sets cannot be sharply in focus at the same time, the screen is always placed so as to focus both sets equally well. Further experiments are described in which the alteration in focal distance by refraction is employed to obtain the same ratios. S. G. S.

1370. *Interference produced in Continuous Spectra by Thick Plates.* **E. Gehrcke** and **O. Reichenheim.** (Deutsch. Phys. Gesell., Verh. 8. 12. pp. 209–221, June 30, 1906. Communication from the Phys.-Techn. Reichsanstalt.)—If homogeneous light, passed through a collimator with a vertical slit, is reflected so as to fall obliquely on a thick glass plate, and after reflection is examined in a telescope, the image of the slit appears traversed by interference bands: if the light used is mixed (*e.g.*, white) and before first reflection is passed through a train of prisms with vertical refracting edges, the spectrum formed is traversed by oblique interference bands. This obliquity is altered if the plate is rotated about a horizontal axis, and there is one position of the plate for which the clearness of the bands is a maximum, being then, moreover, independent of the width of the slit. In this position the plate is nearly parallel to the slit, and the bands are but slightly inclined to the Fraunhofer lines seen in white light if the slit is narrow. Much greater clearness in this best position is obtained if the light is allowed to fall upon the plate *before* instead of *after* passing through the spectroscopic arrangement, and with a Rowland concave grating of 7 m. radius and a plate 1 cm. thick 42 interference bands have been observed and photographed between the D lines in the spectrum of first order. These interference bands may obviously be used advantageously in the measurement of wave-lengths, and in correcting the irregularities produced by defective gratings. R. E. B.

1371. *Measurement of Refractive Index with the Interferometer.* **J. C. Shedd** and **P. Fitch.** (Phys. Rev. 22. pp. 345–350, June, 1906.)—The ordinary interferometer method is modified to determine the thickness of the specimen in terms of the wave-length instead of using a micrometer or other mechanical device. A lamina of uniform optical structure having been secured, it is silvered on half of one side and pressed against the interferometer mirror, first with the silvered side out and afterwards reversed. In these two positions the numbers of fringes are counted on transition from one surface to another, and the thicknesses of the lamina and silver film calculated from the observations. G. E. A.

1372. *Dispersion in Electric Double Refraction.* **H. L. Blackwell.** (Amer. Acad., Proc. 41. No. 30. pp. 647–667, May, 1906. Contribution from the Jefferson Phys. Lab., Harvard University.)—The dielectric of a charged condenser has the optical property of a uniaxial crystal, some dielectrics behaving like positive, some like negative crystals. Carbon disulphide belongs to the former class, and Kerr found for this substance that the double refraction varies inversely as the square root of the wave-length. A strong beam of polarised light is sent between the plates of a condenser immersed in CS_2; the condenser consists of two long silvered strips of optical glass fixed in a specially enamelled iron tube 110 cm. long. Working with a potential gradient of 56,000 volts per cm., the dispersion measured by a Babinet compensator is shown not to conform with the law suggested by Kerr, the curves giving the relation between double refraction and wave-length being more convex to the axes than the hyperbolas drawn according to the above rule. The voltage employed was taken from a battery of 20,000 storage cells, used in conjunction with a resistance built up of 90 coils each of 10,000 ohms, and was measured by a Crompton potentiometer. The optical measurements were made from photographic records, and the carbon disulphide was carefully purified before use. G. E. A.

1373. *Improvements in the Diffraction Process of Colour Photography.* **H. E. Ives.** (Phys. Rev. 22. pp. 339–344, June, 1906.)—Wood's process [Abstract No. 1664 (1899)] although of great theoretical interest and apparent simplicity, fails to give satisfactory pictures, the fundamental defect lying in the superposition of the gratings. In the improved method a screen C, ruled with at least 200 opaque lines to the inch, the opaque lines being twice the width of the transparent spaces between, is superimposed on a glass diffraction grating B, and that again on a bichromated gelatine plate A. On this combination a lens throws the picture of a three-colour positive, one of a set of ordinary three-colour positives. The grating B is one of a set of three, each calculated to send one of the primary colours to a given point, say, 2,400 lines to the inch for red, 3,000 for green, and 3,600 for blue. By shifting the screen C the breadth of a transparent space, and using the three gratings in turn along with the corresponding positives, three exposures are made, so that on development of A a picture is obtained made up of alternating strips of three different grating spacings in which the strips run at right angles to the grating lines. In a further modification of the original method, the colour effects are obtained with a single grating by rotation of the latter combined with the use of a rather long illuminating slit. In an apparatus designed by F. E. Ives for observing the pictures, the light is received from four slits each furnishing one spectrum, and reflected from an oblique mirror through the diffraction picture placed between two lenses. In this way two first and two second order spectra are utilised. The results obtained rival those of the Kromskop. G. E. A.

1374. *Interferential Photography.* **Ponsot.** (Comptes Rendus, 142. pp. 1506–1509, June 25, 1906.)—A thin gelatine layer impregnated with silver bromide being put on a surface of mercury, spectra produced by interference, with the light incident both normally and obliquely and both polarised and non-polarised, were photographed. Examination of the photographs in white light under normal incidence shows a displacement of the colours towards the violet, and the more the larger the angle of incidence : at 28° in the gelatine the red begins on the part of the plate where the yellow acted, and at angle 45° where the blue indigo was. When the photographs were examined in obliquely falling light the colours were displaced towards the red : in light at 45° the colour seen at a point is that of the region of the spectrum which fell on the sensitive plate at this point under the same incidence. If the light is polarised in the plane of incidence the colours observed are very brilliant and purer than with unpolarised light. If the light is polarised perpendicularly to the plane of incidence the colours become duller and duller and finally disappear under the incidence of 45° in the gelatine. Similar results were obtained when the mercury surface was dispensed with, but under the same conditions of exposure and light the colours seen at any point of a plate are not the same as with the mercury. [Errata, 143. p. 148, July 9.] R. E. B.

1375. *Sensitiveness of the Retina to Luminous Radiations.* **M. Štefánik.** (Comptes Rendus, 142. pp. 1569–1570, June 25, 1906.)—The author has extended to the ultra-violet region of the spectrum his method of increasing the visibility of the infra-red by employing coloured screens to absorb neighbouring radiations [see next Abstract and Abstract No. 1058 (1906)]. With an aniline violet screen, he can easily see to measure as far as λ3880 (L.), the H and K region being rendered extremely brilliant, though there is great loss of light in the optical glasses of the apparatus. Without a screen the visible limit, according to *l'Annuaire du Bureau des Longitudes,* is about λ3980. Millochau has shown that the photographic and visual limits are the same. It appears, therefore, that the retina is sensitive to all luminous radiations which the spectroscope allows to pass. By employing instruments less absorbent for the extreme rays, the known limits of retinal sensitiveness will probably be extended. The method is recommended for the study of the spectra of the chromosphere and reversing layer, which are still unknown in the infra-red region, it having now been proved that the eye can easily perceive these radiations. A. E.

1376. *Photography of the Infra-red Spectrum.* **G. Millochau.** (Comptes Rendus, 142. pp. 1407–1408, June 18, 1906.)—The results obtained by Štefánik [see Abstract No. 1058 (1906)], who succeeded in observing the infra-red spectrum visually down to $\lambda = 1\mu$ by employing screens which absorbed other radiations, led the author to experiment photographically in the same region. The well-known property possessed by the infra-red rays, of destroying photographic action on a sensitive plate previously solarised, was utilised. By employing such a plate, and interposing, between the projecting lens and the slit of the spectroscope, a deep red screen consisting of an alcoholic solution of chrysoïdine, malachite green, and aniline violet, it was found easy to photograph the infra-red solar spectrum as far as Φ, though there was considerable loss of light in the apparatus. It was noticed that the action of the infra-red rays on a gelatino-bromide film is superficial, even when the actinic rays used in solarisation penetrate deeply. The best results would therefore be obtained by employing plates specially prepared to prevent penetration of actinic rays, having the emulsion either very thin, or coloured red or yellow. A. E.

1377. *Spectra of Sulphur Dioxide.* **F. Lowater.** (Astrophys. Journ. 23. pp. 324–342, May, 1906.)—The paper is in two parts, dealing with (1) the absorption spectrum, (2) the band emission spectrum of sulphur dioxide. In the first investigation the gas was enclosed in a steel tube, 207 cm. long, having its ends closed by quartz plates, provided with special valves for exhaustion and admission of the gas. The spectrograph had quartz lenses and a grating with 14,438 lines to the inch. The wave-lengths and intensities of the chief bands are tabulated, these being practically confined to the violet and ultra-violet regions, between λλ4100–2100. There is an apparent regularity in the differences of the wave-numbers of the bands. The second research was to determine the radiation of specially prepared sulphur dioxide. The spectra were obtained with a concave Rowland grating of 180 cm. radius; the spectra were very faint, and exposures from 40–80 hours were necessary. The bands were found to have distinct maxima turned towards the ultra-violet. On taking the reciprocals of the wave-lengths it was found that the bands could be arranged in three series with decreasing differences of wave-numbers.

C. P. B.

1378. *Spectro-analytical Investigations.* **C. Fredenhagen.** (Ann. d. Physik, 20. 1. pp. 133–173, May 11, 1906. Habilitationsschrift, Leipzig.)—The author has made investigation of the spectra of certain metals in the flames of carbon monoxide and of hydrogen in chlorine. In the case of the former the metals give the same spectra as in the ordinary Bunsen flame. No metal, however, gives the same flame spectrum in the hydrogen-chlorine flame as in the Bunsen flame. The alkali metals and thallium give no spectrum at all, while the alkaline earth metals, copper, and some others give the characteristic metallic-chloride spectra. The author concludes that the principal series of K and Na and the green Tl line are the spectra of the oxide, while the subordinate series are the true metallic lines.

E. C. C. B.

1379. *New Apparatus for Spectroscopic Examination of Phosphorescent Substances.* **C. de Watteville.** (Comptes Rendus, 142. pp. 1078–1080, May 14, 1906.)—The substance to be examined is placed in a box in which a small observation window is cut. The phosphorescence is excited by the spark discharge between two electrodes also placed in the box. In order to screen the eye or the photographic plate from the actual light of the spark, the following arrangement is adopted: A circular disc carrying two oblong projections and capable of rapid rotation round its central axis is so mounted that, as the disc rotates, each of the projections in turn passes in front of the window cut in the box. As each projection passes the window, the second projection, by touching a spring, allows the spark to pass between the electrodes. The disc is made to rotate at a speed of 80 revs. per sec.

E. C. C. B.

1380. *Kathodic Phosphorescence of Europium diluted with Lime.* **G. Urbain.** (Comptes Rendus, 142. pp. 1518–1520, June 25, 1906.)—A full account of the spectrum of the binary system europia-lime is given. In addition to the bands mentioned certain others appear, increase, and then decrease in intensity as the proportion of europium diminishes. When, in the ternary system lime-gadolinia-europia, the proportion of gadolinia becomes of the order 1/100, the europium chooses the gadolinia as diluent in preference to the lime. Mixtures are made in which the proportion of

$Gd_2O_3 + Eu_2O_3$ to CaO varies between 1/99 and 5/95; the mixtures poorest in europium give, within these limits of dilution in lime, the spectrum of the binary system gadolinia-europia. The mixtures richest in europium give the spectrum of the system lime-europia so long as the proportion of $Gd_2O_3 + Eu_2O_3$ to CaO is less than 4/99; for greater proportions the spectra of the two binary systems are visible simultaneously. [See also Abstract No. 528 (1906).] G. E. A.

1381. *Fluorescence and Lambert's Law.* **R. W. Wood.** (Phil. Mag. 11. pp. 782–788, June, 1906. Phys. Zeitschr. 7. pp. 475–479, July 1, 1906.)—On passing a spark between cadmium electrodes close to the surface of a solution of fluorescein, the fluorescence, if viewed from below, appears much more brilliant if the light is received at grazing emission, so that the fluorescent surface is foreshortened, than in other positions. Hence Lambert's law does not hold in this case. An experiment is described in which the relative intensity of luminosity of the fluorescence produced in the surface of a crown-glass prism for various angles of emission when viewed from inside is determined. The intensity increases rapidly as the observed surface is foreshortened, and agrees very well with that calculated on the assumption that the radiation from each fluorescent molecule is independent of the direction within the glass, and thus obeys the same law as the radiation from a transparent radiating gas. Outside the medium the radiation falls off very much at grazing emission, owing to internal reflection. That refraction and reflection play a large part in determining the intensity in any direction is shown by placing a quartz plate over the face of the prism, with glycerine between the two. The intensity is now much less when viewed from the glass side, and more when viewed from the quartz side than previously. A surface fluorescence may be produced by allowing canal rays to fall on rock salt; the radiation then obeys the same laws as for an incandescent gas; and from the fact that the emitted light shows the D line as sharply as sodium vapour, the author concludes that the radiation is from sodium molecules that have been wholly freed from the surface. S. G. S.

1382. *Absorption of β-rays of Radium.* **V. J. Laine.** (Phys. Zeitschr. 7. pp. 419–421, June 15, 1906.)—The expression $k\sqrt[3]{Ad^2}$ is obtained, for the absorption coefficient, a, of any material, for the β-rays of radium, A being the atomic weight of the material, d its density, and k a constant. The relative absorption produced by plates of different metals is found by a photographic method, and a, $\sqrt[3]{Ad^2}$ and $a/\sqrt[3]{Ad^2}$ are tabulated. The values of the ratio all lie between 4·20 and 5·31, while a varies from 24 for Al to 198 for Pt. The results of experiment are thus in good agreement with the formula. S. G. S.

1383. *Occlusion of Radium Emanation.* **L. Bunzl.** (Akad. Wiss. Wien, Sitz. Ber. 115. 2a. pp. 21–31, Jan., 1906 From the II. Phys. Inst. d. k.k. Univ., Wien.)—Celluloid and indiarubber have a remarkable faculty of occluding radium emanation. This occlusion may be discovered by an irregularity in the curve of secondary radio-activity. The kink in the curve, which implies a retardation in the rate of decay, is produced partly by occlusion of emanation and partly by the residual activity, which, according to Rutherford, sets in when the original activity has fallen to $\frac{1}{10000}$ part of its initial value. These two elements can only be separated by using a strong radio-active influence to begin with. Caoutchouc and tinder show a distinct occlusion, which becomes evident a few hours after exposure. Metals, like copper and platinum, probably also produce some occlusion or adsorption, but that is not yet clearly established. Of all the substances hitherto investigated, charcoal shows by far the greatest occlusion, its behaviour in this respect being similar to its occlusion of other gases. Even after 6 days the activity of activated charcoal is as intense as that of other occluding bodies is after a few hours. The emanation slowly diffuses out, but cannot be completely expelled by heating. E. E. F.

1384. *Radium F. (Polonium).* **S. Meyer and E. v. Schweidler.** (Akad. Wiss. Wien, Sitz. Ber. 115. 2a. pp. 63–88, Jan., 1906. From the Inst. f. theoret. Physik and the II. Phys. Inst. der k.k. Univ., Wien.)—The authors have determined the time the activity takes to fall to half value for the remanent activity from radium, radio-lead, radiotellurium, radio-bismuth. The mean of seventeen observations gives its value as 137·0 days. They consider that Rutherford's and Boltwood's suggestion that lead is the final product of the disintegration somewhat improbable, and show how it is possible to arrange the known active substances according to the periodic law. R. S. W.

1385. *Separation of Radium* C *from Radium* B. **F. v. Lerch.** (Ann. d. Physik, 20. 2. pp. 345–354, June 1, 1906. II. Phys. Inst. d. Univ., Wien. Akad. Wiss. Wien, Sitz. Ber. 115. 2a. pp. 197–208, Feb., 1906. Écl. Électr. 48. pp. 65–68, July 14, 1906.)—If a copper or nickel rod is immersed in a solution of radium B and C, the Ra C is deposited on the rod. It may also be separated by electrolysis, using small current densities; it is then deposited on the platinum kathode. The anode remains inactive if acid solutions are used; in neutral solutions it becomes slightly active, and strongly active in solutions which are alkaline. If $BaSO_4$ is precipitated from a mixed solution, radium C is found in the filtrate, while Ra B is carried down by the barium. The author agrees with Bronson that the times taken for the activity to fall to half value usually given are too long. He obtains 26·7 min. for Ra B and 19·5 min. for Ra C. Bronson [Abstract No. 307 (1906)] has given 26 and 19 min. respectively. R. S. W.

1386. *Activity of Thorium Minerals and Salts.* **B. B. Boltwood.** (Amer. Journ. Sci. 21. pp. 415–426, June, 1906. Paper read before the Amer. Phys. Soc., Feb. 24, 1906. Phys. Zeitschr. 7. pp. 482–489, July 15, 1906.)—The activity due to 1 gm. of thorium in different minerals is determined and is found to be constant. Certain commercial salts of thorium contain only about one-half of the equilibrium quantity of radio-thorium. R. S. W.

1387. *Activity of the Salts of Radium.* **B. B. Boltwood.** (Amer. Journ. Sci. 21. pp. 409–414, June, 1906. Paper read before the Amer. Phys. Soc., Feb. 24, 1906. Phys. Zeitschr. 7. pp. 489–492, July 15, 1906.)—The salts are freed from emanation and their activity tested at intervals; finally the activity due to the emanation accumulated in them is measured. It is found that about 70 per cent. of the emanation formed is actually retained by the salt, which is in the form of a thin film. The ratio of the activity of a salt containing all its emanation to its initial activity, when no emanation is present, is found to be

5·64, as the mean of three determinations. If the ranges of the α-particles from Ra, Ra A, Ra C and the emanation are added together, their sum is 19·6 or 5·60 times the range of the α-particle from radium itself, which is nearly the same as 5·64. It appears highly probable that the α-ray activities of the different products are proportional to the ranges of their α-particles, and that the ionisation produced by each particle is proportional to its range.
R. S. W.

1388. *Radio-activity of Thorium.* **H. M. Dadourian.** (Amer. Journ. Sci. 21. pp. 427–432, June, 1906. Paper read before the Amer. Phys. Soc., Feb. 24, 1906. Phys. Zeitschr. 7. pp. 453–456, July 1, 1906.)—Experiments were undertaken with a view to proving definitely that radio-thorium is a disintegration product of thorium, although Hahn only succeeded in separating it from thorianite. The author tested thorite, thorianite, and five specimens of thorium nitrate. He finds that all the results are consistent with the hypothesis that radio-thorium is a disintegration product of thorium and the producer of thorium X. Thorium emanation being a radio-active product of thorium X, the amount given off by a substance is proportional to the quantity of thorium X present. For a substance in which thorium X and radio-thorium are in radio-active equilibrium, the quantity of thorium emanation given off will be proportional to the amount of both thorium X and radio-thorium, but not necessarily to that of thorium present in the substance. This explains various irregularities of radio-activity observed. If, however, all three—thorium, radio-thorium, and thorium X—are in radio-active equilibrium, the proportionality will hold for each of them. The fact that one of the thorium nitrates, which was prepared over three years ago, was notably deficient in radio-thorium, indicates that the rate of recovery and consequently the rate of decay of radio-thorium is very slow, and that the half-value period cannot be below 2 years. E. E. F.

1389. *Radio-activity of Thorium.* **J. Elster** and **H. Geitel.** (Phys. Zeitschr. 7. pp. 445–452, July 1, 1906.)—From the sediments of the thermal springs of Bad Nauheim and Bad Kreuznach preparations are obtained which have much greater radio-activity than thorium, but whose induced activity has a rate of decay almost identical with that of thorium. The authors consider that the active substance is the radio-thorium of O. Hahn [see Abstracts Nos. 1398 and 2189 (1905)]. Under the conditions of experiment used throughout, the activity of thorium hydroxide is represented by 6,100 volts drop per hour per gm. of substance employed. From the Bad Kreuznach sediment a preparation was obtained whose activity is 321,000 in the above scale. The induced activity is compared with that for thorium hydroxide, and for an interval of 48 hours the rates of decay are practically identical. To establish the identity of radio-thorium as the active constituent of thorium, the rates of decay of activity of radio-thorium X and thorium X are compared, Hahn's observations being repeated. The two are very nearly the same. The same conclusion, that thorium owes its radio-activity to radio-thorium, is strengthened by the fact that the authors succeeded in separating by chemical means from thorium hydroxide a substance which has 12 times the radio-activity of the original substance. S. G. S.

1390. *Radio-activity of Snow.* **G. Costanzo** and **C. Negro.** (Phys. Zeitschr. 7. pp. 350–353, May 15, 1906. From the Italian.)—The authors' observations partly agree, and partly do not, with those of Allan, of Jaufmann, and Righi [see Abstracts Nos. 1033, 1066 (1904) and 892 (1906)]; but whilst no simple general law can be derived connecting the radio-activity with meteorological phenomena, the following facts are quoted: (1) Freshly fallen snow, when collected at once, is strongly radio-active. (2) The activity is found to almost completely disappear after 2 hours. (3) Snow which has fallen on the ground appears to retain its activity somewhat longer than when it has fallen on a roof. L. H. W.

1391. *Radio-activity of the Ash and Lava from the April Eruption of Vesuvius.* **A. Becker.** (Ann. d. Physik, 20. 3. pp. 634–638, June 26, 1906.)—This investigation was undertaken as a test of the theories of the distribution of radium within the earth. The ash and lava show nearly equal radio-activity—about 3½ times that of Kiel garden soil, which is, however, 20 times less active than Wolfenbüttel garden soil, so that the products of the eruption, that must have come from a considerable depth, are less active than most layers of the earth's surface. The observations further show that there is about 2×10^{-11} gm. of radium in 1 c.cm. of lava—a number closely agreeing with Strutt's [see Abstract No. 1285 (1906)]—and they indicate a decrease in radio-activity down to a depth of 30 km. R. E. B.

REFERENCES.

1392. *Colour Sensitiveness of Normal and Colour-blind Eyes.* **O. Steindler.** (Akad. Wiss. Wien, Sitz. Ber. 115. 2a. pp. 39–62, Jan., 1906. From the II. phys. Inst. der k.k. Univ., Wien.)—A review of the results of various experiments by previous workers in this field and the hypotheses held concerning them. The paper contains elaborate tables of observations and is illustrated by a number of curves showing the sensitiveness to different colours, of the eyes of normal and typical colour-blind persons. E. H. B.

1393. *Spectrum of the Glow of Radio-tellurium.* **B. Walter.** (Ann. d. Physik, 20. 2. pp. 327–332, June 1, 1906. Phys. Staatslaborat. Hamburg, Feb., 1906. Écl. Électr. 48. pp. 26–27, July 7, 1906.)—The author finds on comparing the spectra of the glow of radiotellurium (polonium) with those of nitrogen, that the former closely resembles the spectrum of the positive column of a nitrogen-filled vacuum tube. The glow of radium, as is well known, gives the same spectrum as the kathode glow of nitrogen. E. C. C. B.

1394. *Spectral Analysis by Dispersion.* **M. Laue.** (Deutsch. Phys. Gesell., Verh. 8. 10. pp. 170–180, May 30, 1906.)—A *résumé* and discussion of recent work upon the above subject by Rayleigh, Schuster, and Larmor. [See Abstracts Nos. 746 (1904) and 86, 556 (1906).] E. H. B.

1395. *Analysis of the Finest Spectrum Lines by Interference Points obtained with Plane-parallel Plates.* **E. Gehrcke** and **O. v. Baeyer.** (Ann. d. Physik, 20. 2. pp. 269–292, June 1, 1906. Communication from the Phys.-Techn. Reichsanstalt.)—A more detailed application of the method already described in previous papers [see Abstracts Nos. 1752 (1905) and 518 (1906)]. The following spectra were examined: Hg, Cd, Zn, Bi, Te, Ag, Pb, H_2, He, A, and Na. E. C. C. B.

1396. *Decay of Phosphorescence in Sidot Blende.* **E. L. Nichols** and **E. Merritt.** (Phys. Rev. 22. pp. 279–293, May, 1906. Paper read before the Amer. Physical Soc., Oct. 28, 1905.)—The full paper corresponding to Abstract No. 709 (1906).

1397. *Influence of very strong Electromagnetic Fields on the Spark Spectra of* (1) *Vanadium and* (2) *Platinum and Iridium.* **J. E. Purvis.** (Cambridge Phil. Soc., Trans. 20. No. 8. pp. 193–214, May 15, 1906.)—The author has measured the value of $d\lambda/\lambda^2$ for many lines in the spark spectra of the above metals, using a 21-ft. grating and a field of 39,980 units. The results are given at length in the paper. [See also Abstract No. 1595 (1905).] E. C. C. B.

1398. *New Method of Photographing Medals.* **E. Demole.** (Comptes Rendus, 142. p. 1409, June 18, 1906.)—Medals can rarely be photographed directly, and a double moulding is usually made. But, as the photographic objective makes no distinction between a concave impression and the same design in relief, this is taken advantage of, and an impression of the medal is made on dull lead paper, and photographed from the concave side on silver bromide paper, a positive of the medal being obtained. The impression is illuminated obliquely, and development stopped when the surface of the medal is sufficiently brought out. G. E. A.

1399. *Action of Radium on Gelatine.* **J. B. Burke.** (Roentgen Soc., Journ. 2. pp. 34–37; Discussion, pp. 37–40, Dec., 1905.)—A further contribution to the subject for which the original should be referred to. [See also Liége Congrès de Radiologie, Report, pp. 1–13, 1905; also Electrician, 57. pp. 342–343, June 15, 1906.] **W. A. D. Rudge.** (Cambridge Phil. Soc., Proc. 13. pp. 258–259, May 15, 1906.)—Rudge gives a more detailed account of the experiments described in Abstract No. 542 (1906). These are considered to prove conclusively that radium has no specific action upon gelatine, any effect noticed being held to be due to the barium in the radium salt acting upon the sulphur compounds present in the gelatine, and no effect whatever being produced when once these compounds have been removed. L. H. W.

1400. *New Element Presenting the Radio-active Characteristics of Thorium.* **G. A. Blanc.** (Accad. Lincei, Atti, 15. pp. 328–335, March 18, and pp. 349–355, April 1, 1906.)—The present paper gives particulars of comparative experiments which enable an exact comparison to be made between thorium salts and the Savoy thermal muds; the results confirm the conclusion previously reached [see Abstract No. 2212 (1905)]. D. H. J.

1401. *Action of Becquerel Rays on Water.* **F. Kohlrausch.** (Ann. d. Physik, 20. 1. pp. 87–95, May 11, 1906.)—A further account of experiments already described [see Abstract No. 545 (1904)]. J. J. S.

1402. *A Variety of Thorianite from Galle, Ceylon.* **W. R. Dunstan** and **B. M. Jones.** (Roy. Soc., Proc. Ser. A. 77. pp. 546–549, June 21, 1906.)—Specimens of thorianite have been examined which contain from 58 to 67 per cent. of thoria, whilst specimens from other localities usually contain 76 to 79 per cent. In the mineral now examined the deficiency of thoria is compensated by an exceptionally large proportion of urania. It is suggested that the two elements are isomorphous, and that the mixed minerals are isomorphous mixtures or solid solutions. [See Abstract No. 2210 (1905).] T. M. L.

1403. *a-Rays of Radium.* **W. H. Bragg.** (Phys. Zeitschr. 7. pp. 452–453, July 1, 1906. From the English.)—It is pointed out that the experiments of P. Ewers [see Abstract No. 718 (1906)], in which it is shown that the *a*-rays emitted by polonium are positively charged when emitted, and do not acquire their charge subsequently in travelling through the gas, afford confirmation of the author's theory, that the *a*-rays acquire their positive charge by collision, an electron being thereby lost [see Abstracts Nos. 355 and 747 (1905)]. The collisions which produce this loss occur within the solid material, so that the *a*-rays emerge positively charged. S. G. S.

HEAT.

1404. *Recording Calorimeter for Gas. Relation of Flame Temperature to Calorific Power.* **J. W. Bain** and **J. W. Batten.** (Soc. Chem. Ind., Journ. 25. pp. 505–507, June 15, 1906. Paper read before the Canadian Section, May 10, 1906.)—The authors made simultaneous determinations of flame temperature with a le Chatelier thermo-couple, and of calorific power with a Junker's calorimeter, with a view to utilising a continuous record of temperature as a continuous index of calorific value. In experiments in which coal-gas was burned more or less diluted with CO_2, it was found that if the thermo-junction were placed so as to be at all times above the flame, there was a maximum difference of 2 per cent. between the flame temperature and the calorific power, which is equal to the possible error in reading the calorimeter. F. R.

1405. *Emission of Carbon in Certain Flames.* **A. Amerio.** (Accad. Sci. Torino, Atti, 41. 5. pp. 290–300, 1905–1906.)—The author shows that the carbon of the flame of illuminating gas is not black, nor is it even grey for the whole length of the spectrum, but only for wave-lengths equal to or less than $1{\cdot}5\,\mu$; for greater wave-lengths it has a relatively weak absorbing power. Nevertheless the flame of acetylene emits carbon sensibly as a black body. The temperatures of emission of the particles of carbon in these flames, and probably also in others (those of petroleum, oil, &c.), can be calculated on the basis of Wien's laws of displacement as if the carbon were a black substance.

T. H. P.

1406. *Radiation of Black Bodies and Doppler's Principle.* **M. Cantor.** (Ann. d. Physik, 20. 2. pp. 333–344, June 1, 1906.)—Instead of invoking Doppler's principle to obtain Wien's law of radiation, the author first thermodynamically deduces the relation $e/t^4 = F(tv^{\frac{1}{3}})$ where e is the radiation-energy per unit volume, and then, by showing that displacement of a mirror produces stationary waves with wave-lengths increased in a ratio dependent on the rate of displacement, the relation $\lambda/v^{\frac{1}{3}} = \text{const.}$, whence $e = t^4 f(\lambda t)$. Doppler's principle then follows from this result. The first relation above is obtained practically by substituting ve for E and $\frac{1}{3}e$ for p in the equation $\partial E/\partial v = t\partial p/\partial t - p$. This is not new in principle. R. E. B.

1407. *Thermodynamic Theory of Radiation.* **J. H. Jeans.** (Phil. Mag. 12. pp. 57–60, July, 1906.)—Assuming with other considerations that the source of radiation is the motion of electric charges in the radiator, the author obtained [see Abstract No. 382 (1906)] the same expressions, viz., $\lambda^{-4}Tf(\lambda T)d\lambda$ and σT^4, for the law of partition of radiant energy and for the total energy of radiation per unit volume as are given by the thermodynamic theory. This theory gives σ as dependent on the electric charges only, and it is supported by their deduced magnitude from the observed value of σ being $1{\cdot}8 \times 10^{-10}$ electrostatic units. In the thermodynamic theory, however, σ enters as a constant of integration so that we only know its dimensions, and these we cannot obtain from combining properties of the æther only, which alone is concerned in the theory; still, by taking into account also some physical constant associated with matter which is common to all kinds of matter—such as the charge e of an electron—we can obtain an evaluation of σ. But on thermodynamic principles there would be nothing to prevent our considering the effect of introducing into an enclosure an ideal substance in which each electron has the charge $\frac{1}{2}e$, and this would be to destroy equilibrium of temperature—which is not an acceptable result. Another illustration is given which also seems adverse to the thermodynamic theory. R. E. B.

1408. *Kinetic Theory of Gases.* **H. Poincaré.** (Soc. Franç. Phys., Bull. 2. pp. 150–184, 1906. Journ. de Physique, 5. pp. 369–403, June, 1906.)—In the proof of the continuous increase of the entropy, Gibbs' reasoning seems to suppose that after having varied the external conditions we wait till equilibrium is established before proceeding to vary them again. The author examines the necessity of this condition, and concludes that it is only with this condition that the proposition can be affirmed. This is, however, with regard to the entropy usually considered—what he calls the *gross* entropy, as being that which is estimated for domains that are not infinitely small, but only smaller than our usual means of investigation can distinguish; what he calls the *fine* entropy—that which is estimated for domains that are infinitely small—is finite on the continuous hypothesis, and is of constant magnitude whatever variations go on in the system. R. E. B.

1409. *Vibrating Systems not Subject to the Boltzmann-Maxwell Law.* **W. Peddie.** (Roy. Soc. Edinburgh, Proc. 26. pp. 130–141, 1905–1906.)—Cases are here determined in which equipartition of vibrational energy cannot take place. The cases determined present analogies to the molecular systems of luminous gases, so that it appears possible for gaseous systems to be free from subjection to the law of equipartition of energy within their vibratory freedoms; and it further appears that in the liquid and isotropic solid states equipartition of energy among all freedoms may be possible even though impossible in sparse gases. R. E. B.

1410. *Isothermal Distillation of Nitrogen and Oxygen and of Argon and Oxygen.* **J. K. H. Inglis.** (Phil. Mag. 11. pp. 640–658, May, 1906. Communicated by the Physical Soc., Jan. 26, 1906.)—In determining the relation connecting the composition of the vapour with the composition of the liquid when a mixture of two liquids is distilled isothermally, it is important to ensure that the vapour is in complete equilibrium with the liquid: this the author effects by causing the vapour to circulate through and through the liquid until no further change in either takes place, and circulation for at least 10 minutes was found to be necessary. Two series of experiments were made on mixtures of nitrogen and oxygen, and it was found that $r'/r = a - bm$, where r' and r are the ratios of the amounts of nitrogen and oxygen in the vapour and liquid respectively, m the molecular percentage of nitrogen in the liquid, and a, b functions of the temperature which are 6·60 and 0·028 at 74·7° abs. and 5·48 and 0·0207 at 79·07° abs. Thus r'/r is not constant at any temperature as Henry's law would give, and a discussion of the results shows that, though the solubility of nitrogen in oxygen obeys Henry's law quite rigidly up to a molecular percentage of nearly 70 per cent., oxygen does not obey this law; this result is supported by a re-discussion of v. Zawidzki's experiments, so that it may be concluded that oxygen is associated when dissolved in nitrogen and also in the pure state. A few experiments were made at 82·09° abs. on mixtures of argon and oxygen: in one case oxygen was added in small quantities to pure argon with a vapour pressure 41·1 cm., and the pressure increased to 42 cm., above which it did not rise so long as any of the argon remained solid. It hence appears that the separation of a solid from a liquid in which it is soluble is a much more complicated distillation process than the separation of two liquids. R. E. B.

1411. *Liquefaction of Air by Expansion against Pressure.* **G. Claude.** (Comptes Rendus, 142. pp. 1333–1335, June 11, 1906. Soc. Franç. Phys., Bull. 1. pp. 26–45, 1906.)—Liquefaction of air is very advantageously effected when the air is initially at its critical pressure of about 40 atmospheres, and is cooled by the circulation around it of air which has been cooled by expansion, but to no great extent. The author's arrangement is this: a tube is connected with two liquefiers and an expanding chamber; compressed air is led into this, some going to fill the liquefiers and the remainder passing into the chamber, where it is expanded to fall only to about —160° C., passing then round the first liquefier wherein it produces liquefaction at —140°, to which temperature it rises itself, then passing on through a second similar expanding chamber, whereby it again falls to —160°, afterwards circulating round the second liquefier and acting on it as before, and finally passing away round the inlet tube and so cooling the entering compressed air. By this method 850 c.cm. of liquid air have been obtained per h.p.-hour. R. E. B.

1412. *Thermodynamics of Diffusion.* **G. H. Bryan.** (Nature, 74. p. 246, July 12, 1906.)—This note directs attention to some points easily overlooked. One of the most important is that the possibility of producing mechanical work by the diffusion of gases through a membrane at constant temperature is not necessarily inconsistent with the principles of thermodynamics or the ordinary definitions of a perfect gas. It is pointed out that in diffusion the change of entropy, if existent, cannot be expressed as a sum of differentials of the form $d\mathrm{Q}/\mathrm{T}$; it is suggested, further, that the constants of integration that enter into the expression for the entropy of a gas may, for all we know thermodynamically, change in the process of its diffusion. R. E. B.

1413. *Specific Heats and Corresponding States.* **E. H. Amagat.** (Comptes Rendus, 142. pp. 1303–1309, June 11, and 143. pp. 6–7, July 2, 1906.)—The discontinuity of the isometric specific heat which occurs at the saturation point [see Abstract No. 1257 (1906)] does not vanish at the critical point; for, though $(\partial p/\partial t)_u - df/dt$ vanishes at this point, so too does $d \log t/ds$, and it is their ratio (which is finite) that measures the discontinuity. Calculation for CO_2 gives the following values in thermal units :—

$t-237$	$c_1 - c$	$c_1' - c'$	$t-237$	$c_1 - c$	$c_1' - c'$
0	0·24	1·52	20	0·41	1·20
5	0·28	1·36	25	0·48	1·13
10	0·33	1·26	30	0·91	1·36[1]
15	0·37	1·23			

[1] Faulty.

showing that the discontinuity increases on the liquid side and decreases on the vapour side as the temperature rises. We have always $c_1' - c_1$ positive, these being the values for the mixed state when all vapour or all liquid, and calculation seems also to show that, at least up to 25°, $c' - c$ is positive, but the data are insufficient to determine its sign at higher temperatures. There is no corresponding discontinuity of the isopiestic specific heat on crossing the saturation-curve, but calculation seems to show that its value for saturated liquid exceeds its value for saturated vapour, and the more the higher the temperature. The results of a former paper [see Physical Soc. Abstracts, No. 250 (1897)] are then extended, reason being given for concluding that the molecular specific heats (whether isopiestic or isometric) of fluids conforming to the law of corresponding temperatures are equal if they are equal for the fluids when in the perfectly gaseous state. In explanation of the discontinuities the author points out in his last note that c_1, c_1' are not true specific heats, as they have reference to a partial change of state as well as to a change of temperature; he further adds that c, c' have no true meaning within the saturation-curve. [The latter statement is not necessarily true: the obvious explanation of the discontinuities is that c, c' are the isometric specific heats *without* change of state and c_1, c_1' the isometric specific heats *with partial* change of state.] R. E. B.

REFERENCES.

1414. *Vapour Pressure of Sulphur.* **W. Matthies.** (Phys. Zeitschr. 7. pp. 395-397, June 1, 1906. Phys. Inst., Erlangen, March, 1906.)—By the dynamical method the author has determined the vapour pressures of sulphur at low temperatures. The results show a pressure of 250·1 mm. of mercury at a boiling temperature of 379·4°, and a pressure of 1·35 mm. at a temperature of 210·2°. The curve expressing the results is concordant with that of Bodenstein for higher pressures; Regnault's values are slightly too low. D. H. J.

1415. *Gibbs' Theory of Entropy-Increase.* **T. Ehrenfest** and **P. Ehrenfest.** (Akad. Wiss. Wien, Sitz. Ber. 115. 2a. pp. 89-98, Jan., 1906.)—On the theory the entropy is measurable by the average value of the logarithm of the reciprocal of the density. In estimating this the authors contend that Gibbs, though taking into account the non-homogeneity of the fluid, has not taken its incompressibility properly into account, so that he has used wrong expressions, and consequently has not proved what he set out to prove, and that therefore the basis of his theory of irreversible processes is so far without proof. R. E. B.

1416. *Thermodynamics of Interference Phenomena.* **M. Laue.** (Ann. d. Physik, 20. 2. pp. 365-378, June 1, 1906.)—A discussion, from the points of view of entropy and probability, of the interference of two beams of radiation, and in which reference is made to the recent work of J. H. Jeans [Abstract No. 332 (1906)]. E. H. B.

1417. H-*Theorem and the Dynamical Theory of Gases.* **J. H. Jeans.** (Phil. Mag. 12. pp. 60-62, July, 1906.)—Burbury's objections [see Abstract No. 1038 (1906)] to Jeans' work, which purports to be based on no physical foundations except the laws of dynamics, are either vague or ill-founded. Neither the author nor the molecules of a gas have made Burbury's Assumption A. R. E. B.

SOUND.

1418. *Projection of Vibration Curves and Determination of Frequency.* **S. Mikola.** (Ann. d. Physik, 20. 3. pp. 619–626, June 26, 1906.)—An essential part of the apparatus for this graphical experiment is a cylinder rotating uniformly about a vertical axis and provided on its surface with fine vertical white and black lines. On this cylindrical striped surface the shadow of, say, a vibrating string is optically projected. Suppose first the cylinder had only a single narrow white stripe, then as it moves horizontally and the string's shadow rises and falls we have a displacement-time curve exhibited. Further, if with a number of black and white stripes, the frequency of their passage is made any exact multiple of the frequency of the string's vibration, we have this curve exhibited steadily and presented as many times as one frequency is a multiple of the other. Hence, if the frequencies are equal the single curve only is seen and is quite steady. Thus the frequency can be ascertained by a suitable motor and other accessories. E. H. B.

1419. *The Syakuhati : a Japanese Wind Instrument.* **T. Terada.** (Physico-Mathematical Soc., Tokyo, Proc. 3. 4. pp. 83–87, May, 1906.)—The *Syakuhati*, a popular Japanese instrument, derives its name from its length, being one *syaku* and eight (*hati*) *sun* for the key *d* (*itikotu*). It is cut from a well-seasoned bamboo near its root, in such a way that both its ends correspond to knots. The interior of the pipe, which slightly contracts toward the lower end, is cleared of the partitions at the knots and well varnished. The pipe usually curves forward slightly. The front edge of the upper end is partially cut down with an angle of about 30° to the direction of the length, forming a sharp knife-edge. In playing, the upper end is applied between the lower lip and the chin so that a narrow curved aperture is left between the lip and the knife-edge, to which the jet of air from the mouth is directed. Of the five lateral openings possessed by the instrument the uppermost is at the rear and the rest on the front side of the pipe. The *Syakuhati* is to be considered as a form of organ-pipe whose effective length is varied, not only by means of the five lateral openings as in other wind instruments of the kind, but also by adjusting the area of the mouth at which it is blown. The latter adjustment which characterises this pipe is usually made by changing its inclination relative to the player's head, thus causing a change of the aperture between the lip and the edge of the pipe. The angle through which this adjustment can be made is about 10°, producing a change in pitch of about one whole tone. By means of this peculiar adjustment, the instrument may speak a note of any pitch within its compass, notwithstanding the small number of the lateral openings. In this respect the *Syakuhati* is comparable rather with a stringed instrument than a flute. The theory of the instrument is then discussed, reference being made to the work of Helmholtz, Rayleigh, and Cavaillé-Coll. E. H. B.

REFERENCE.

1420. *Resonator.* **H. Michel.** (Scientific American, 93. p. 319, Oct. 21, 1905. From Prometheus.)—A form of resonator is described in which a light vane suspended in a resonance box sets itself parallel to the direction of motion of the air when the box is resounding. In rotating the vane closes an electric circuit, and thus sets in action some indicator. S. G. S.

ELECTRICITY AND MAGNETISM.

THEORY, ELECTROSTATICS, AND ATMOSPHERIC ELECTRICITY.

1421. *Magnetic Inertia of Charged Sphere in Electric Field.* **G. F. C. Searle.** (Nature, 74. pp. 198–199, June 28, 1906.)—O. Heaviside has investigated [see Abstract No. 1089 (1906)] the slow motion of a charged conducting sphere through a uniform electric field, in a direction *parallel* to the electric force of the field, and has calculated the increase in the magnetic energy and inertia of the sphere resulting from the redistribution of the charge under the influence of the field. His paper suggested the present investigation, in which the slow motion of the sphere is *at right angles to* the direction of the electric field. But, as Heaviside pointed out, this problem has no single definite solution. For, if the sphere, initially at rest in the field, be set in motion, the motion of the unequally-distributed charges on the surface of the sphere will tend to give rise to magnetic force in the interior; but the magnetic force will only gradually penetrate into the interior, and electric currents circulating in the sphere in parallel planes will give rise to a magnetic force opposed to that due to the moving charges. If the conductivity be perfect these currents will persist, and the interior of the sphere will be permanently free from either electric or magnetic force; but with finite conductivity the currents will die away, and the magnetic force will finally attain a definite value inside the sphere, although the electric force vanishes. For each of these cases a solution is found; but while the currents are dying away the magnetic energy gradually changes, and the calculation of the energy at any given time might be difficult. Hence this paper is confined to the two limiting cases; these are worked out and expressions found for the energy and magnetic field. The results show that if an electron be a conducting sphere of radius 10^{-13} cm. with a charge of 10^{-20} electromagnetic units, an electric force of 1 billion volts, or 10^{20} c.g.s. units per cm., would not change its magnetic inertia by so much as one part in 10 billions, and the results are of no consequence in experiments on the electrostatic deflection of kathode rays; but it is possible that there are other cases where it would be necessary to take the change of magnetic inertia into account. When u becomes comparable with v the analysis becomes more complicated, but does not present any difficulty, at least in the final stage, with finite conductivity, provided a Heaviside ellipsoid be substituted for a sphere.

E. H. B.

DISCHARGE AND OSCILLATIONS.

1422. *Condensation of Vapours in Ionised Air.* **K. Przibram.** (Akad. Wiss. Wien, Sitz. Ber. 115. 2a. pp. 33–38, Jan., 1906. From the Inst. f. theoret. Physik an der k.k. Univ., Wien.)—The author makes the significant discovery that, contrary to what happens in the case of water, the vapour of alcohol is more easily condensed on positive air ions than on negative air ions. In water, according to Wilson, condensation may be produced on negative ions by sudden expansion in ratios ranging from 1·25 to 1·31, and condensation on both positive and negative ions by higher ratios. A thick fog is produced in water vapour by a sudden expansion in the ratio 1·31 : 1.

This ratio becomes 1·304 in methyl alcohol, 1·194 in ethyl alcohol, 1·201 in propyl alcohol, 1·214 in isobutylalcohol, 1·228 in isoamylalcohol, and 1·653 in chloroform. The sign of the preferred ions was determined by using two bottles containing layers of mercury in alcohol, surmounted at some distance by flat electrodes. These electrodes were given opposite signs, and a thin layer of air just above the liquid was ionised by means of a flat pencil of Röntgen rays. The space above the liquid was therefore filled with either positive or negative ions at will. In methyl alcohol, condensation on positive ions commences at an expansion ratio of 1·242, and on both kinds of ions at an expansion ratio of 1·309. E. E. F.

1423. *Theory of the Singing Arc.* **H. T. Simon.** (Phys. Zeitschr. 7. pp. 433–445, July 1, 1906. Inst. f. angew. Elektrizität, Göttingen, May, 1906. Écl. Electr. 48. pp. 139–142, July 28, and pp. 179–182, Aug. 4, 1906.)—The paper opens with a general discussion of the equations for the current in the circuit in parallel with the singing arc. It is assumed that the current in the main circuit is constant, and it is shown by obtaining the wave-form of the currents in the main and arc circuits simultaneously by means of the oscillograph that this assumption is justified. The curve for the arc circuit is of the wave-form, that is, an approximately sine curve superimposed upon a straight line, and the curve for the main current is nearly a straight line. From the theory it follows that for the maintenance of undamped vibrations in a parallel circuit, a conductor (as, for example, the arc) must possess a falling characteristic, *i.e.*, the p.d. in it must decrease with increasing current and *vice versâ*. But certain facts concerning the singing arc, such as the necessity for solid carbons, although cored carbons give a falling characteristic, the change of frequency with length of arc, and the limit of frequency attainable, however the capacity and inductance of the parallel circuit may be varied, have not hitherto been accounted for. The author now applies his theory of the arc [see Abstract No. 1465 (1905)] to account for these facts, and with this in view the characteristics are obtained under various conditions, by obtaining, by means of the oscillograph, the curves for p.d. and current, and plotting p.d. against current for a whole cycle. From the characteristic the course of change of the currents in arc and condenser circuits can be traced, and it is noticed that although some parts of the curve are rising the general form of the curve indicates a falling tendency. The greater this falling tendency, the more easily is energy drawn from the arc circuit by the condenser circuit, and the more readily can oscillations be set up. At high p.d. and small current (long arc) the conditions are as required, and this accounts for the ease with which oscillations are then set up. Oscillograms for the sudden setting up of oscillations in several cases are given, from which it is deduced that with diminution of current in the arc the amplitude and the periodic time increase, until the arc becomes extinguished. The author then modifies his original equation $ei = W(FT)$ by introducing a term involving changing (FT) on account of the oscillations, which then becomes $ei = W(FT) + L\,d(FT)/dt$. By assuming a sine variation of (FT) with time it is shown how the static characteristic can be modified to fit this new case of the singing arc, and by taking values for the constants W and L the characteristics for various values of p.d. and current are drawn; it is at once seen that this is much more "falling" in the case of small currents and high p.d. than *vice versâ*. By increasing the frequency the longer axis of the characteristic is rotated so as to become more horizontal, showing that frequencies above a certain limit cannot be attained. The effects of amplitude, length of arc, and of electrode material are also indicated. For an increase in the value of W/L the characteristic is rendered steeper and the limit of possible frequency raised; since W decreases with increasing conductivity, the difficulty of obtaining oscillations with cored carbons is explained. A long arc, although giving high p.d. and small current, and therefore favourable to the production of oscillations, is extremely liable to extinction, and hence the author suggests the use of several arcs in series; the current being then unchanged, the e.m.f.'s are added and the steepness of the characteristic increased, thus raising the limit of frequency obtainable. Much of the detail of the paper cannot be adequately abstracted and the original should be consulted.

S. G. S.

1424. *Electric Field of Force.* **J. S. Townsend.** (Phil. Mag. 11. pp. 729–745, June, 1906.)—Large variations in the electric field accompany changes in the current between two parallel plates in a gas. Experiments were made with a view to obtaining evidence as to the nature of these changes. The results are in good accordance with the author's theory [see Abstract No. 1084 (1905)], but it is difficult to obtain accurate determinations of the electric field. Even a fine wire is apt to disturb the potential in the gas, and it does not in general acquire the potential at any point which would exist there if the wire were removed. In hydrogen, at pressures ranging from 2 to 9 mm., the probe gives true indications at a point 6 mm. from the kathode, when the distance between anode and kathode amounts to 8 mm. The connections from the electrode and the exploring wire to the terminals of the voltmeter must be made through high resistances of about 5 megohms, to eliminate the effects of capacity. Between 6 and 7 mm. from the negative electrode the positive and negative ionic currents are equal, so that in that neighbourhood the wire takes up the true potential of the gas. Nearer the positive electrode, the wire assumes a potential much lower than that of the gas. There is no reliable evidence to show that the so-called anode fall of potential really exists. E. E. F.

1425. *Photo-electric Effect and Kathode-fall at an Alkali Electrode in Argon, Helium, and Hydrogen.* **H. Dember.** (Ann. d. Physik, 20. 2. pp. 379–397, June 1, 1906. Abridged Inaug.-Dissertation, Berlin, March 17, 1906. Écl. Électr. 48. pp. 62–65, July 14, 1906.)—An experimental work of which the main results may be summarised as follows: (1) The photo-electric sensitiveness of the K-Na alloy is greater in helium than in hydrogen. This holds also if the ultra-violet rays from the source of light are stopped. (2) The values of the kathode-fall at platinum in helium found by Strutt, Defregger, and the present author are respectively 226, 160, and 165 volts. Thus Strutt's value is not confirmed. (3) Strutt's value for the kathode-fall at platinum in argon was 167 volts, which the present author approximately confirms by finding 163 volts. (4) For the kathode-fall of the K-Na alloy in argon (63), a smaller value is found than for the same metal in helium (78·5). (5) For higher voltages the photo-electric sensitiveness of the K-Na alloy is greater in argon than in helium. [See also Abstracts Nos. 1432, 1433 (1903), 2957 and 2992 (1904).] E. H. B.

1426. *Fall of Potential in the Positive Layer in Hydrogen.* **P. B. Pentscheff.** (Phys. Zeitschr. 7. p. 463, July 1, 1906.)—Hydrogen prepared by electrolysis is passed through a heated palladium tube into an experimental tube prepared by repeated evacuation and filling with the pure gas under the action of a strong discharge. Small quantities of other gases exert a large influence on the striation in hydrogen, the presence of mercury vapour causing each stria to divide into two differently coloured parts. In pure hydrogen the striation is simple and the colouring homogeneous along the axis of the stria. Also, the purer the hydrogen the smaller is the range of current strength and gaseous pressure within which the positive luminous column is striated. With increasing current strength the fall of potential in the positive layer increases with constant pressure, and diminishes with decreasing pressure and constant current, in no case falling below 20 volts; the highest value was 55 volts. In impure hydrogen the fall of potential varied between 13 and 45 volts. [See also Abstract No. 1378 (1902).]

G. E. A.

1427. *Canal Rays.* **H. Rau.** (Phys. Zeitschr. 7. pp. 421–423, June 15, 1906.)—Wien found that after repeatedly renewing and drying the hydrogen in the vacuum tube, the fluorescence of the glass produced by the canal rays exhibited the green luminescence and not the sodium light. [See Abstract No. 2251 (1902).] In oxygen under the same conditions the fluorescence consists chiefly of the yellow sodium light. The author repeats these experiments, and in addition uses nitrogen, the object being to see whether the character of the fluorescence depends upon chemical reaction. The effect is exactly as with oxygen, but it is pointed out that sodium nitride is formed. Hence helium is next employed, and the result is the same as that with hydrogen, thus confirming the view that the effect is largely a chemical one and is not due to the high temperature produced locally by the canal rays. Several experiments are mentioned, in which the ratio e/m is determined by the magnetic and electrostatic deflection of the canal rays in helium and in hydrogen, but the results are not entirely satisfactory. Also experiments are given which verify J. Stark's observation of the Doppler-effect in the case of the canal rays in hydrogen [see Abstract No. 297 (1906)] and the identity of the positive ions as the emitters of the line-spectra [Abstract No. 889 (1906)].

S. G. S.

1428. *Temperature and Heat-conductivity of the Positive Column.* **J. E. Lilienfeld.** (Deutsch. Phys. Gesell., Verh. 8. 11. pp. 182–196, June 15, 1906. Phys. Inst. d. Univ., Leipzig, May 3, 1906.)—The part of the positive column experimented upon is far removed from the electrodes. These consist of large cylindrical conductors of aluminium, each being situated in a spherical bulb, the bulbs being united by a U-tube at the bottom of which is a smaller bulb. In this smaller bulb is situated a thin platinum strip which is heated by a subsidiary current, its temperature being determined differently in two sets of experiments. In the first, one junction of a thermo-couple is soldered to the middle of the strip, while in the second the resistance of the strip is determined by measuring the current and the p.d. between the ends. The U-tube and bulb are surrounded by ice, so that the walls of the enclosure in which the heated strip is placed may be considered to be at 0° C. To maintain the strip at a given temperature, energy must be supplied to it at a rate depending upon the rate of radiation, of conduction through the metal, and upon the conductivity of the gas. When the strip is maintained at the temperature of the gas, the heat conducted away from it by the gas is zero, and hence the loss due to radiation, &c., is the same as for a vacuum; and it is shown by the author that for this rate of supply of energy, the difference between the temperatures with and without the discharge passing is a maximum. By obtaining the positions of this maximum for different discharge currents in several gases, it is shown that the heat-conductivity is greater when the discharge is passing than when it is not, the temperature of the gas being the same in both cases; also that under the given conditions the strip does not take the temperature of the gas in which it is placed. The heat-conductivity and temperature of the positive column are much higher in the case of hydrogen then in that of oxygen or nitrogen. S. G. S.

1429. *Aurora Borealis.* **P. Villard.** (Comptes Rendus, 142. pp. 1330–1333, June 11, 1906.)—If in the field of a magnet a kathode-corpuscle were projected in the equatorial plane it would describe an epitrochoidal curve in this plane, with an eastward trend if the field were oriented as that of the earth. If it were projected obliquely to this plane on its northern side its path would be somewhat of the same character, only drawn out like a helix and still with easterly trend, but, while first tending northerly, it would bend back southerly on reaching some particular magnetic latitude, only again at another particular latitude to bend back northerly, and so on indefinitely, but always with easterly trend and with perfect symmetry. This tubular path as a whole would form a zigzag sheet about the axis of the field, limited at its ends by two magnetic parallels. The diameters of the spires and the rate of eastward trend would diminish with the strength of the field. If now a negatively electrified cirrus were to discharge itself under the ultra-violet light of the sun or otherwise it would give off a broad parallel kathodic beam oblique to the earth's field. Then the above phenomena would occur and they would explain the appearances that characterise the *aurora borealis*—its rays (due to superposition of paths where bent back and consequent increase of brightness), its draperies (due to breadth of the spires and consequent overlapping), its arc (the parallel which limits the rays), its trend, and its rotation under the influence of variation in the earth's field. The author has observed all these effects with a large spherical kathode tube. R. E. B.

1430. *Electric Resistance of Solenoids for High-frequency Currents.* **A. Battelli.** (Accad. Lincei, Atti, 15. pp. 471–480, May 6, and pp. 529–539, May 20, 1906.)—The results given in a previous paper [see Abstract No. 958 (1906)] are not valid for currents of very high frequency. In the present paper it is shown that for currents of very high frequency the current density on passing from one surface for which R = constant to the next, varies according to the same law in the case of cylindrical as in the case of plane conductors; *i.e.*, $\theta = \theta_0 e^{-\alpha S} \cos(\omega t - \alpha S)$, where $\alpha = \sqrt{2\pi\omega\mu/\sigma}$, μ being the permeability and σ the specific conductivity of the medium, and S the distance of the point under consideration from the surface of the medium. This result is then applied to the problem of the determination of the resistance of a solenoid. It then appears that the resistance varies as the fourth root of the frequency, *i.e.*, $R/R' = K\sqrt[4]{1/T}$. On comparing the results of experiments with this formula a good agreement is found between the limits $T = 2{\cdot}2 \times 10^{-6}$ and $T = 4{\cdot}3 \times 10^{-6}$. Further experiments are to be made and communicated later. S. G. S.

1431. *Hertz Oscillators and Radiation Measurements by Resonators.* **C. Schaefer** and **M. Laugwitz.** (Ann. d. Physik, 20. 2. pp. 355–364, June 1, 1906. Phys. Inst. d. Univ., Breslau, March, 1906. Écl. Électr. 48. pp. 110–112, July 21, 1906.)—Prompted by recent work and views supposed to be held by

M. Paetzold [see Abstract No. 570 (1906)] and previous work by Garbasso, Aschkinass, and Schaefer [Abstract No. 1925 (1901)], the present authors here debate the much-discussed question as to whether a Hertz oscillator emits damped radiation of a definite wave-length or emits a continuous spectrum. Conflicting as these views seem, it is here pointed out that B. E. Lommel gave, in 1885, the following formula, which shows that a modified form of a continuous spectrum is equivalent to a damped wave-train of single definite frequency. Thus Lommel's equation may be written—

$$e^{-kt}\sin(nt+\phi)=\frac{k}{\pi}\int_{-\infty}^{+\infty}\frac{\sin[(n+z)t+\phi]dz}{k^2+z^2}.$$

Hence the damped vibrations of definite frequency expressed by the left side are equivalent to the superposition of the infinite series of undamped vibrations of continuously varying frequency expressed by the right side. It should also be noticed that the amplitudes of the undamped vibrations have a maximum for the frequency expressed by the left side, and fall off somewhat rapidly in a manner depending on the damping constant *k*, for frequencies either higher or lower. This view of the matter has been expressed by J. v. Geitler as follows: "Optically speaking, an ordinary Hertzian oscillator sends out a spectrum which consists of only a single line, *but which, in consequence of the damping, is not completely sharp, but is more or less broadened out.*" The bearing of this new view of the matter on the classical controversy is then discussed at considerable length. [See also Abstract No. 803 (1905).] E. H. B.

ELECTRICAL PROPERTIES AND INSTRUMENTS.

1432. *Mercurous Sulphate and Standard Cells.* **G. A. Hulett.** (Phys. Rev. 22. pp. 321–338, June, 1906. Electrician, 57. pp. 708–711, Aug. 17, 1906.)—The question as to the best method of preparing the mercurous sulphate and the depolariser for standard cells does not yet seem to be satisfactorily settled. H. v. Steinwehr [Abstract No. 1931 (1905)] concludes that the principal, if not the only cause of the variation of the e.m.f. of standard cells, is traceable to a difference in the size of the particles of the mercurous sulphate. It is well known that a fine-grained sample of a salt has a greater solubility, and therefore its solution will have a greater e.m.f. than that of a coarser-grained sample. The difference may not, however, be measurable. Experimental evidence on this point is contained in a table of values of cadmium cells made by the author. In the case of 14 of these cells the size of the particles varies considerably, but the e.m.f.'s are all in good agreement. Furthermore, a few cells which contain coarse-grained crystals have higher e.m.f.'s than others containing small crystals but prepared in a different manner. From these results it is concluded that the effect of the size of particles, in the electrolytic preparations, is not measurable, and that whatever deviations there are must have some other explanation. It has been previously suggested by the author [Abstract No. 1277 (1905)] that the differences are due to hydrolysis of the sulphate, and this view is supported by further experiments on salts prepared with acids of different concentrations. A cell prepared with Kahlbaum's mercurous sulphate, the latter being washed with water in the usual way, gave at first an e.m.f. 0·003 volt higher than the normal, and after several months was about 0·0008 volt higher. The apparatus employed for the preparation of electrolytic mercurous sulphate is described. F. E. S.

1433. *Electric Viscosity.* **A. Broca.** (Comptes Rendus, 142. pp. 1328–1330, June 11, 1906.)—The author has previously shown that, in the case of metals, the observed phenomena of the resistance and also the reflecting power of a wire subjected to electric alternations are accounted for in the expression $K/2cT = A$, A being a quantity which from $T = 3 \times 10^6$ to $T = 10^{13}$ varies between 1·2 and 1·5. K is the specific inductive capacity and c the conductance; T is the period of the alternations. In collaboration with Turchini, the author has recently shown that electrolytes show even greater variations than metals, relative to the resistance of cylindrical conductors, for currents of high frequency. The phenomena may be explained on the same suppositions as for the case of metals. For acidulated water $K/2cT$ appears to have the value 0·80 [see Abstract No. 2252 (1905)]. The difference between the two calculations is that instead of using Bessel's functions it is necessary, in the case of electrolytes, to use a series, the first two or three terms of which are sufficient, since only small values of the variable occur. Taking u as the intensity vector and P the vector of the e.m.f at any point, we have the relation $4\pi u = 4\pi c P + K dP/dt$. If P has the form $P = P_0 e^{-(\alpha t + \beta z)} \sin 2\pi(t/T - z/\lambda)$ corresponding to a plane polarised wave, damped and absorbed, then $u = A \sin 2\pi(t/T - z/\lambda + \phi)$, so that the term $K dP/dt$ introduces a difference of phase between the current and the e.m.f., thus acting like capacity in a circuit—

$$A = cP_0 e^{-(\alpha t + \beta z)} \sqrt{\left(1 - \frac{K}{2cT} \cdot \frac{\alpha T}{2\pi}\right)^2 + \frac{K^2}{4c^2T^2}}$$

and—

$$\tan 2\pi\phi = \frac{K}{2cT\left(1 - \frac{K}{2cT} \cdot \frac{\alpha T}{2\pi}\right)}$$

The amplitude of the total current is therefore not the sum of the conduction current and the displacement current; the conductance acts like viscosity. The effect depends, moreover, essentially on the value of the variable $K/2cT$, which defines in a sufficient manner this viscosity or, by analogy with magnetism, *hysteresis*. The damping $\alpha T/2\pi$ occurs in the formulæ; but, with the values which actually occur, the effect of the damping on the phase ϕ and on the amplitude is negligible. The author therefore calls the expression $K/2cT$ the *constant of electric viscosity*. There is also a retardation of the magnetic field on the current. Maxwell's equations become in the case considered—

$$4\pi u = dY/dz \quad \text{or} \quad Y = 4\pi A e^{-\alpha t} \int e^{-\beta z} \sin 2\pi(t/T - z/\lambda + \phi)\, dz,$$

which gives finally—

$$Y = 4\pi A e^{-(\alpha t + \beta z)} \sin 2\pi(t/T - z/\lambda + \phi + \phi')$$

with—

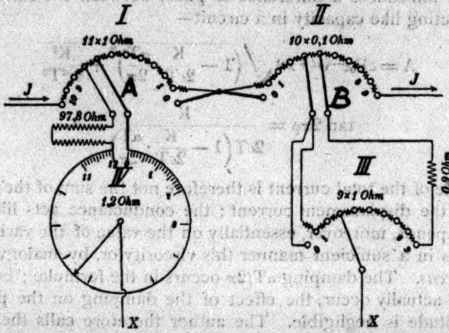
$$\tan 2\pi\phi' = 1/0{\cdot}23 \sqrt{v^2 cT},$$

v being the velocity of light and c and T as before. This tangent, for the heat waves of Rubens, is very small, so that the angle $2\pi\phi'$ is very small; the difference of phase, therefore, between the magnetic force and the current is also very small. The viscosity-constant has an extremely slow variation, so the phenomenon must be nearly the same in all conductors.

A. W.

1434. *New Vacuum Meter.* **W. Voege.** (Phys. Zeitschr. 7. pp. 498–500, July 15, 1906.)—The possibility of using the vacuum thermo-element as a simple and convenient measurer of the degree of exhaustion has been pointed out [see Abstract No. 1118 (1906)]. The author now gives the results of two series of comparative readings of a McLeod gauge and of a milli-voltmeter connected to the thermo-element. The exhaustion varied from 1·64 mm. down to 0·002 mm. The voltmeter readings plotted as ordinates against pressure show that from 1 mm. down to 0·8 mm. these readings are approximately inversely proportional to the pressure, rising more rapidly than the inverse of pressure between 0·1 and 0·01 mm. The apparatus is now made by F. Ehrenberg, of Hamburg. L. H. W.

1435. *Low-resistance Potentiometer.* **H. Diesselhorst.** (Zeitschr. Instrumentenk. 26. pp. 173–184, June, 1906. Communication from the Phys.-Techn. Reichsanstalt.)—In order to obtain small subdivisions of the total fall of potential in a potentiometer of the ordinary form it is necessary to use a graduated slide wire with a number of additional sections of equal resistance in series; the whole making up a relatively large total resistance. To obviate this condition various methods have been suggested, in which the galvanometer connections, instead of being brought directly to the main dials or slide wires, are brought to contact-arms on secondary dials or slide wires, the ends of which are connected by double contact-arms to the studs in the primary dials so as to form shunts to the individual sections. By moving the galvanometer connections over the studs of the secondary dials subdivisions of the potential drop in the primary sections are readily obtained. The figure illustrates the principle as applied by the author, the chief improvement claimed being that of rendering the contact resistances of the arms A and B negligible by employing high resistances in the secondary dials or slide wires as at III. and IV. In order to avoid thermo-electric troubles at the contacts and joints, the whole of the working parts are enclosed in a box containing petroleum and provided with a stirrer. The paper contains an interesting epitome of methods previously suggested by Varley, Harker, Raps, Franke, Lehfeldt, and others. J. D. C.



ALTERNATING CURRENTS AND MAGNETISM.

1436. *Measurement of small High-frequency Currents.* **B. Gati.** (Electrical World, 47. pp. 1341–1343, June 30, 1906.)—The author deals with the method of measuring small currents by means of a hot-wire barretter, as employed by Kennelly [Abstract No. 2962B (1904)] for measurements with telephonic circuits. The lag between the e.m.f. and the current may be obtained by means of a three-barretter method, the calculations for which are the same as for the three-ammeter method of measuring power; the method of connecting up with three barretters, each having its own bridge arrangement is illustrated. The effective (ohmic) resistance, effective inductivity and capacity, and the "conductance" can then be calculated. The special form of barretter used by the author is described; the platinum wire is 5 μ in diam. Hints are given for carrying out the experiments. L. H. W.

1437. *Measurement of Weak Alternating Currents.* **J. K. A. Wertheim-Salomonson.** (Phys. Zeitschr. 7. pp. 463–465, July 1, 1906.)—I. Klemenčič's method, in which the current is led through two wires of iron and constantan twisted together in the middle and having the free ends connected to a galvanometer, is made more sensitive and reliable. Two parallel rows of thermo-junctions have their ends connected to a sensitive galvanometer, and their middle points to the source of alternating current, thus forming a Wheatstone bridge; one arm contains a variable resistance adjusted so that no part of the external current affects the galvanometer. In order that only the alternate contacts may be heated by the current, the second, fourth, sixth, &c., are made of thick plates, and the first, third, fifth, &c., of thin wires, the thermo-junctions occurring only at the junction of plate with plate and wire with wire, *i.e.*, plates and wires of the same material are joined together. In the apparatus used there are 10 iron-constantan elements, and a current of 1 milliamp. excites a thermo-e.m.f. of 7·5 microvolts. With a delicate galvanometer a current of 2×10^{-5} amp. could be detected. G. E. A.

1438. *Permeability and Retentiveness of Iron Filings.* **B. O. Peirce.** (Amer. Acad., Proc. 42. No. 3. pp. 87–91, June, 1906. Contribution from the Jefferson Phys. Lab., Harvard College.)—The material was in the form of fine milled cast-iron particles tamped into a glass tube, the length being 50 diameters and the density 4/10ths that of solid material. For a field of 255 gausses, $B = 2{,}100$, whence $I = 147$ (about). With field removed $I = 20·8$; coercive force, 16 (about). The demagnetising effect is very small owing to the low value of I for a given value of H. Reference is made to Maurain and to Trenkle [see Abstract No. 945 (1906)]. L. H. W.

1439. *Magnetic Properties of Manganese-Boron Alloys.* **B. du Jassonneix.** (Comptes Rendus, 142. pp. 1336–1338, June 11, 1906.)—Glass tubes filled with the powdered alloys, containing from 0 to 21 per cent. boron, have been inserted in a coil through which was passed an electric current, and the induction produced on breaking the circuit, both before and after the introduction of the glass tubes, measured. Alloys containing 14–15 per cent. boron have a maximum permeability which is greater than that of the definite boride MnB, probably due to the presence in alloys containing above 15 per cent. boron, of a small quantity of the boride MnB_2, which is found to be non-magnetic. W. H. Si.

ELECTROPHYSIOLOGY AND ELECTROTHERAPEUTICS.

1440. *Physiological Effects of Currents of High Tension and Frequency.* **A. d'Arsonval.** (Électricien, 31. pp. 241-244, April 21; 258-261, April 28, and pp. 279-284, May 5, 1906. Paper read before the École professionnelle supérieure des Postes et des Télég., March 14, 1906.)—A *résumé.* One or two experimental arrangements and observations may be referred to. Frequencies up to 10,000 per sec. are obtained by the author by means of a special alternator. For higher frequencies a long iron rod, clamped in the middle in a vice, and having one end in proximity to a magnet between the poles of which a winding is placed, is stroked by drawing across it a piece of cloth upon which rosin has been rubbed. The vibrations set up in the rod give rise to high-frequency currents in the winding; the frequency may reach 80,000 per sec. For large amounts of energy, some method of extinguishing the arc is necessary with transformers. The magnetic blow-out is considered too complicated, and the author employs as spark-electrodes two rapidly rotating rods. With this arrangement it is found that when the rods rotate synchronously with the alternator supplying the current, sparks which appear fixed in space are obtained between the balls, a single spark being produced at the exact instant when the amplitude of each cycle is a maximum. With the spark-gap adjusted for a definite current, on gradually increasing such current, no longer a single spark, but two, three, four, five or six sparks, according to the strength of the current, are obtained, showing that the condenser is charged two, three, four, &c., times in the course of one cycle. Analysed by means of the revolving mirror, it is found that the frequency of the induced current can be varied by this means, *i.e.*, by merely increasing the primary current. L. H. W.

1441. *New Chromoradiometer.* **H. Bordier.** (Archives d'Él. Médicale, 14. pp. 363-381, May 25, and pp. 415-428, June 10, 1906.)—The author criticises the various methods of qualitative and quantitative measurement of the Röntgen rays, none of which can be relied upon in clinical work to ensure accurate dosage. The new chromoradiometer is based on the colour changes of barium platinocyanide. After the salt has been dehydrated by the action of the rays, re-hydration takes place, especially in the presence of light, but the return to the initial condition is not perfect. Complete re-hydration can, however, be obtained by treating with water and recrystallising. [See Abstract No. 1868 (1905).] Pastilles of barium platinocyanide, included in collodion, 6¼ mm. square are employed. These are fixed to a specially prepared paper label, gummed on the reverse side, and this label is applied to the protecting material which surrounds the area of the skin to be treated, so that the pastille is as close as possible to this area and on the same plane. On the label the area which is to surround the pastille is coloured to the tint which it is required that the pastille should acquire. Four tints are employed. The first represents a dose such as will produce in a healthy skin a reaction of the first degree, and should be followed by an interval of one month before the next *séance.* The second tint, a sulphur yellow, indicates a dose which in a healthy skin would produce an erythema with swelling and final desquamation. The latent period of this dose is 12 to 15 days. It is employed in the treatment of acne, lichen planus, certain forms of eczema and psoriasis, and in internal tumours. Tint III. corresponds to an exposure which will produce in a healthy skin true radio-dermatitis with vesication after an interval of 8-10 days. It is applied to lupus patches of old standing, certain epitheliomata, and erectile tumours. Tint IV., which is chestnut-brown, indicates the dose for the destruction of ulcerated or warty epitheliomata, and would produce ulceration and necrosis of healthy skin. The author directs that the tube employed must not be too soft, because in that case the effect is complicated by the action of ultra-violet rays given off by the tube, and that a pastille should not be used a second time. He quotes cases illustrated by photographs, showing the excellent results obtained by his method, in which, as a rule, only one application of the rays is employed.

H. W. P. Y.

REFERENCES.

1442. *Electron Theory.* **H. A. Lorentz.** (Archives Néerlandaises, 11. pp. 1-52, 1906.)—A fuller treatment, with additions dealing with the Hall-effect, and further notes, of the paper dealt with in Abstract No. 1910 (1905).

1443. *Movements of Electrons in Metals.* **R. Gans.** (Ann. d. Physik, 20. 2. pp. 293-326, June 1, 1906. Phys. Inst., Tübingen, March, 1906.)—The greater part of this paper is mathematical and treats of the following subjects: Theories of Lorentz, Riecke, and Drude [Abstracts Nos. 1276 (1900) and 577 (1905)]; Deviation from Maxwell's law of partition; Electron current and heat current; Hall-effect and dependence of conductivity on strength of magnetic field; Approximate theory for fields of small magnets; Isothermal and adiabatic processes. There are also two sections experimentally treated, dealing with the Hall-effect and the conductivity of bismuth for direct and alternating currents. E. H. B.

1444. *Franklin as Man of Science and Inventor.* **E. J. Houston.** (Frank. Inst., Journ. 161. pp. 241-316, April, and pp. 321-383, May, 1906. Address on 200th anniversary of birth of Benjamin Franklin.)—Deals with the whole range of Franklin's experiments.

1445. *Deviation of Dielectric Ellipsoid in an Electric Field; Specific Inductive Capacity of Water.* **F. Beaulard.** (Journ. de Physique, 5. pp. 165-181, March, 1906.)—A much fuller account of the investigation dealt with in Abstract No. 2097 (1905).

1446. *Study of Dielectric Liquids.* **G. Gouré de Villemontée.** (Journ. de Physique, 5. pp. 403-420, June, 1906. Paper read before the Soc. franç. de Physique, Feb. 16, 1906.)—A fuller treatment of the subject dealt with in Abstract No. 2096 (1905).

1447. *Influence of the Boundary of an Electrostatic Condenser.* **R. Magini.** (Accad. Lincei, Atti, 15. pp. 442-450, April 22, 1906.)—Condensers are constructed and their capacities measured with and without guard rings at three different distances from the earthed plate, with the object of finding the value for experimental purposes of the expressions previously obtained for the effect of the boundary upon the capacity [see Abstracts Nos. 775 and 962 (1906)]. Circular and elliptical condensers are employed, and the results show that formulæ are only applicable for certain thicknesses of air-space between the plates. S. G. S.

1448. *Measurement of very short Time-intervals.* **Devaux-Charbonnel.** (Comptes Rendus, 142. pp. 1080-1082, May 14, 1906. Electricien, 31. pp. 386-389, June 23, 1906.)—A method of measuring short intervals of time by observing the amount to which a condenser is discharged, by a ballistic galvanometer.

E. C. C. B.

1449. *Change of Resistance with Induction.* **E. Bose.** (Phys. Zeitschr. 7. p. 462, July 1, 1906.)—More thorough experiments on the above subject lead the author to withdraw his previous paper [Abstract No. 1265 (1906)], the effect of a leakage current from the influence machine into the Wheatstone bridge circuit having been mistaken for a change of resistance. The opinion is now put forward that certain proof of the change of resistance with induction can only be furnished by means of experiments made in the highest vacua, and such experiments have been begun. G. E. A.

1450. *Electrical Conductivity and Thermal Absorptive Power of Minerals.* **J. Koenigsberger** and **O. Reichenheim.** (Centralblatt. Min. pp. 454–470, 1905.)—The electrical conductivity and the absorptive and reflective powers for heat radiations of a number of minerals (hæmatite, marcasite, pyrites, molybdenite, stibnite, galena, chalcocite, and graphite) have been examined, the results obtained being in agreement with Maxwell's equation $n^2\kappa = \sigma\tau$, where n = index of refraction, k that of absorption, σ is the conductivity, and τ the period of the electromagnetic vibration. [See Abstracts Nos. 62 and 64 (1904).] L. H. W.

1451. *Electrolytic Wireless Receiver.* **D. L. Beardsley.** (Scientific American, 94. p. 538, June 30, 1906.)—An electrolytic detector is described in which the need for a polarising battery is obviated by using zinc and platinum (the latter for the minute electrode) in dilute sulphuric acid. L. H. W.

1452. *Disturbance of Compass by Currents in Ship's Hull.* **F. Emde, C. Arldt.** (Elektrotechn. Zeitschr. 27. pp. 554–556, June 7, 1906.)—In connection with Arldt's recent paper [Abstract No. 583 (1906)], Emde questions the applicability of the Biot-Savart law to this problem. In reply to this, Arldt points out that the necessary conditions are fulfilled with sufficient accuracy, so far as practical results are concerned. A. H.

1453. *Measurement of Magnetic Fields by Magnetic Resolution of Spectral Lines.* I. **P. Zeeman.** (Konink. Akad. Wetensch. Amsterdam, Versl. 14. pp. 838–841, May 9, 1906. Proc. 8. pp. 814–817, May 25, 1906.)—A method of measuring magnetic fields by photographing the spectrum of mercury, the field being explored with a vacuum tube. E. C. C. B.

1454. *Terrestrial Magnetism and Solar Eclipse.* **A. Nippoldt.** (Phys. Zeitschr. 7. pp. 242–248, April 1, 1906. From paper read before the Berliner Zweigverein d. deutsch. Meteorolog. Gesell. Feb. 6, 1906.)—Curves of variations from mean of the horizontal and vertical force magnetometers at Burgos, Aug., 1905, compared with similar variations determined during the previous eclipse of 1900. [See Abstract No. 929 (1903).] Erratum. (Ibid. p. 368, May 15). C. P. B.

1455. *Comparison of Magnetograms with Sun-spot Variations.* **C. Chree.** (Cambridge Phil. Soc., Trans. 20. No. 7. pp. 165–192, May 15, 1906.)—The results obtained from a discussion of the Falmouth Declination and Horizontal Force Magnetographs on certain selected quiet days are compared with the variations of sun-spot areas as published from the Greenwich measures, the relations being shown by curves and numerous tables. C. P. B.

1456. *The Telecardiogram.* **W. Einthoven.** (Archives Néerlandaises, 11. pp. 239–272, 1906.)—Describes the application of the author's string galvanometer [see Abstract No. 2261 (1905)], to the obtaining of telecardiograms of patients at the hospital of the Leiden University, by means of a twin telephone conductor, partly overhead and partly underground, the galvanometer itself being at the physiological laboratory. Numerous cardiograms are reproduced. L. H. W.

CHEMICAL PHYSICS AND ELECTRO-CHEMISTRY.

1457. *Separation of Radio-thorium from the Muds of Echaillon and Salins Moutier.* **O. Angelucci.** (Accad. Lincei, Atti, 15. pp. 497–500, May 6, 1906.)—The method of separation depends on the solubility of ferric chloride in alcohol, and the insolubility of calcium sulphate in the same medium. The mud is treated with hydrochloric acid, and the insoluble residue (15 per cent.) filtered off; alcohol is added to the filtrate and then dilute sulphuric acid. The resulting precipitate of calcium sulphates (which contains the active principle) is treated several times with dilute HCl, and the different extracts are then precipitated with ammonia. The precipitates thus finally obtained contain the whole of the active principle free from iron, and the mother-liquors contain calcium sulphate together with thorium X. D. H. J.

1458. *Crystallisation.* **J. H. Bowman.** (Soc. Chem. Ind., Journ. 25. pp. 143–145, Feb. 28, 1906. Paper read before the Canadian Section at Toronto, Oct. 19, 1905.)—In explanation of the varying shapes assumed by crystals and of the different conditions under which they are formed, the author puts forward the following hypotheses: (1) That there are lines of force along which crystallisation takes place and which differ in intensity according to the shape of the crystal and also according to their nature, whether principal or subordinate. (2) That the interference with crystallisation referred to occurs because the supply of material is not available to the growing crystal as quickly as the crystallising force requires it. Curving of crystals occurs when the crystallising force is nearly equalled by the resistance of the medium due to its viscosity, the crystal then seeking the line of least resistance, which seems to be a curved one. The paper is illustrated by sketches of actual crystalline shapes. T. H. P.

1459. *Refractive Indices of Crystallising Solutions.* **H. A. Miers** and **Miss F. Isaac.** (Chem. Soc., Journ. 89. pp. 413–454, March, 1906.)—By applying the method previously described [see Abstract No. 1196 (1904)] to solutions of sodium nitrate, chlorate, thiosulphate, and chloride, potassium alum and sulphate, ammonium alum and oxalate, the authors arrive at the following conclusions, which do not, however, hold for sodium chloride, as this salt does not readily form supersaturated solutions: For a cooling supersaturated solution of certain strength there is a temperature t°, at which there occurs a sudden diminution of refractive index, accompanied or followed by copious separation of crystals. The same solution enclosed in a sealed tube cannot be made to crystallise at a lower temperature except by inoculation with a crystal of either the solute or an isomorphous substance. In general, however, the solution in a sealed tube does crystallise at or slightly below t° when shaken, especially if friction is employed. The increase of crystallisation at t° is therefore due to the spontaneous growth of new crystals in addition to those already formed, *i.e.*, at t° the solution passes into the labile state.

T. H. P.

1460. *Influence of Quantity of Substance on Probability of Crystallisation in Undercooled Liquids.* **N. Stücker.** (Akad. Wiss. Wien, Sitz. Ber. 114. 2a.

pp. 1389–1404, Oct., 1905.)—To test Pfaundler's theory, that crystallisation in undercooled liquids is more probable in the case of a large than of a small mass, experiments were made with tubes containing various quantities (5, 10 cm., etc.), of a 31 per cent. solution of saltpetre in water and, in a second set, phenol. It was found that crystallisation was very largely influenced by the area of liquid in contact with glass; thus whilst at low temperatures with rapid crystallisation there was only a small deviation from the behaviour indicated by Pfaundler, at higher temperatures, when crystallisation was less rapid, the smaller volumes of nitrate solution actually crystallised sooner than the larger. Crystallisation was also very greatly accelerated by the addition of glass wool, or by allowing the liquid to come into contact with the sealed point of the tube. T. M. L.

1461. *Theory of Optical Rotation.* **C. Winther.** (Zeitschr. Phys. Chem. 55. pp. 257–280, April 18, 1906. Chem. Universitätslaborat., Kopenhagen, Jan., 1906.)—It is suggested that the two chief factors influencing the specific rotatory power of a compound are: (1) Molecular weight, and (2) molecular volume. In certain cases the rotatory power is not altered by polymerisation or association, and is independent of the molecular weight; when this is so there is a linear relationship between specific rotation and solution volume, and the ratio $\Delta a/\Delta v$ should be independent of the temperature, concentration, and solvent, provided that no association takes place between solvent and solute. A formula is also given for those cases in which the rotatory power is influenced both by molecular weight and by molecular volume. T. M. L.

1462. *Adsorption of Dissolved Substances.* **P. N. Evans.** (Journ. Phys. Chem. 10. pp. 290–298, April, 1906.)—Experiments were made to determine the weight of solute removed by filter-paper from aqueous solutions of hydrogen chloride, sodium chloride, potassium chloride, barium chloride, and copper sulphate. Barium chloride was not adsorbed, and sodium chloride only to a very slight extent. In the other cases no measurable adsorption appeared to take place from the strong solutions, but as the dilution increased the *proportion* of the solute removed increased rapidly; the actual *weight* removed appeared to reach a maximum value and then to decrease towards a constant value in very dilute solutions. T. M. L.

1463. *Freezing-point of Pure Liquids and Solutions under Positive and Negative Pressure.* **C. S. Hudson.** (Phys. Rev. 22. pp. 257–264, May, 1906.) —It has been shown by Hulett (Abstract No. 944 (1903)] that the lower vapour pressure of solutions as compared with the pure solvents indicates that the solutions are under a negative pressure. The author now shows that when the ice is kept under constant pressure, while the pressure on the water-phase is increased by 1 atmosphere, the freezing temperature is raised 0·0824°. In the case of ice in contact with a dilute solution, therefore, since the ice is under atmospheric pressure, the author calculates that the liquid must be under a negative pressure, and assuming that the dissolved substance exerts the same pressure as a gas, the author finds that the negative pressure has the same value as the osmotic pressure. A. F.

1464. *The van't Hoff-Raoult Formula.* **W. D. Bancroft.** (Journ. Phys. Chem. 10. pp. 319–329, May, 1906.)—The author reverts to the van't Hoff formula for osmotic pressure, and points out that in deducing his formula van't Hoff assumed that the vapour of the solvent follows the gas laws, and that the volume of liquid could be neglected in comparison with that of vapour when calculating the work done in an isothermal distillation. Further, the volume used by van't Hoff is equal to the volume of the solution only when the solution is so dilute that the volume of the solute is negligible as compared with that of the solution. Postulating $PV = RT$ we obtain the van't Hoff-Raoult formula $n/N = \log(p_0/p_1)$, where $n =$ number of gm. of solute divided by mol. weight of the solute in the solution, N is the gm. of solvent per mol. weight of solute, divided by the mol. weight of the solvent in the form of vapour, p_0 is the vapour pressure of the pure solvent, and p_1 the partial pressure of the solvent in the solution at the same temperature. The above postulate can be made, however, as van't Hoff pointed out, only when the heat of dilution is negligible. With concentrated solutions, therefore, the osmotic pressure varies with the heat of dilution, and the author shows that if we take this into account the abnormal molecular weights for sodium in mercury, sulphuric acid in water, resorcinol in alcohol, cupric chloride in water, and alcohol in benzene are due wholly or in part to the heats of dilution. The abnormal molecular weights of sodium chloride in water, however, are not due to the heat of dilution. Further, the molecular weights at infinite dilution are correct, but all others are in error to a greater or less extent. The author believes that a quantitative theory of concentrated solutions can be worked out if we make corrections for the heat of dilution.

A. F.

1465. *Osmotic Pressure.* **W. C. D. Whetham.** (Nature, 74. p. 54, May 17, 1906.)—This is a letter by the author, called forth by the paper by Kahlenberg [Abstract No. 1142 (1906)], in which the latter claimed that his experiments invalidate van't Hoff's theory of osmotic pressure by which the concordance between the pressure of gases and the osmotic pressure of dilute solutions was established. In this letter the author recalls the principles on which the theory rests. From the experimental relation between the solubility of a gas and the pressure van't Hoff showed that, on the basis of the second law of thermodynamics, the osmotic pressure of a dilute solution must possess the same value as the ordinary pressure of a gas at the same concentration. The solution must be so dilute that the dissolved systems, each made up of a particle of solute as nucleus and the portion of solvent which it influences, are beyond each other's sphere of action. No assumption is made as to the nature of osmotic pressure. Kahlenberg, however, and those who agree with him seem to consider that the thermodynamic theory of solutions stands or falls with the hypothesis that the pressure is due to molecular bombardment. The author points out, further, that the importance of experiments on osmotic pressure lies in the question how far the assumptions made in the thermodynamic proofs can be realised experimentally. In the case of dilute sugar solutions in water the conditions laid down in the thermodynamic theory can be very approximately realised, as experimental work by various investigators has shown. But where the conditions are not fulfilled—*e.g.*, where the membrane is not truly semi-permeable—then of course the experimental values for the osmotic pressure may deviate widely from the theoretical value. The author also overthrows the assertion of Kahlenberg, that because a perfect semi-permeable membrane does not exist, a theory which postulates one cannot be maintained. The author draws attention to two perfectly semi-permeable membranes, viz., the surface of solvent crystals which separate out on the freezing of a solution, and the free surface of a volatile liquid. He also refers to the warning given by Kahlenberg [not for the first time] that his experiments involve the destruction of the ionic hypothesis, and points out that the abnormally great osmotic pressures point to some kind of dissociation, although they do not indicate the nature of this. The theory of the production of electrically charged systems rests upon electrical evidence, and must be tried by such. **Berkeley** and **E. G. J. Hartley.** (Ibid., pp. 54–55, May 17, and p. 245, July 12.)—Berkeley and Hartley point out that the statement of Kahlenberg, that "indirect measurements of osmotic pressures from vapour tensions, involves the assumption that the gas laws hold for solutions" is wrong. The authors have shown that aqueous solutions of cane sugar give the same osmotic pressure whether observed directly or deduced indirectly from their vapour pressures, and the relation connecting the osmotic and vapour pressures is quite independent of the gas laws holding for solutions. The authors also very pertinently call attention to a typical experiment from which Kahlenberg makes his deduction against the theory of van't Hoff, viz., an experiment dealing with the osmotic pressure of cane sugar in pyridine. From Kahlenberg's own statement that sugar was found outside the membrane, the authors calculate that the amount would correspond with a fall in the pressure gauge of 20 cm. per hour. "No wonder," they remark, "the theoretical pressure was never reached." A. F.

1466. *Osmotic Pressure of Solutions of Non-electrolytes.* **J. J. van Laar.** (Konink. Akad. Wetensch. Amsterdam, Versl. 14. pp. 849–858, May 9, 1906. Proc. 9. pp. 53–63, June 21, 1906.)—Referring to the experimental results of Morse and Frazer [Abstract No. 423 (1906)] on the osmotic pressure of solutions of cane sugar, the author shows that their results agree with his mathematical deduction of the pressure in which, not the volume of the solution, but the volume of the solvent in the solution must be used. The osmotic pressure is thus shown not to be due to a kinetic pressure of the solute molecules, but to be due to a difference in concentration of the solvent outside and inside the semi-permeable membrane; owing to this, diffusion takes place. On account of this a current, having an equivalent of pressure, arises in the transition layer near the semi-permeable membrane, and this current can only be checked by a counter-pressure on the solution of equal value—the so-called osmotic pressure. Nor is it to be expected, except in the limiting condition of infinite dilution, that the osmotic pressure should follow the gas laws. A. F.

1467. *Vapour Pressure and Chemical Composition.* **E. C. Bingham.** (Amer. Chem. Soc., Journ. 28. pp. 717–723, June, 1906.)—As the equation of the vapour-pressure curve of a substance, Nernst proposed the expression—

$$\log_e \frac{\tau}{p} = m \log_e \frac{\tau}{T} + a' \left\{ \left(\frac{\tau}{T} - 1\right) - \frac{1}{n}\left(1 - \frac{T}{\tau}\right) \right\},$$

where τ is the critical temperature. The author finds, from the study of a large number of substances, that this is confirmed, the values of the constants being $m = 1{\cdot}75$, $n = 2{\cdot}36$. The value of a' varies with the substance, and increases quite regularly with the complexity of the molecule. The values of ma', where m is the molecular weight, can be represented by an equation of the form $ma' = 42l + 1{\cdot}9m + 41n + \ldots$, where $l, m, n \ldots$ are the number of atoms of the elements carbon, hydrogen, oxygen, &c., respectively in the molecule. A. F.

1468. *Relation between Vapour Pressures and Composition of a Binary Mixture.* **G. N. Lewis.** (Amer. Chem. Soc., Journ. 28. pp. 569–572, May, 1906. Contribution from the Research Lab. of the Massachusetts Inst. of Technology.)—The author gives an elementary and exact proof of the relation discovered by Duhem, namely, $N dp/p + N' dp'/p' = 0$, where p and p' are the respective partial vapour pressures from a mixture containing N gm.-mols. of the first substance and N′ gm.-mols. of the second, and dp and dp' are the changes in p and p' accompanying a slight change in composition. The proof may be extended to the case where the mixture contains more than two constituents. The equations hold when both the temperature of the mixture is constant and the vapours behave like perfect gases; they are hence only approximations. T. H. P.

1469. *Critical Pressures of Solutions.* **M. Centnerszwer** and **A. Pakalneet.** (Zeitschr. Phys. Chem. 55. pp. 303–314, April 13, 1906.)—The critical pressures of pure ethyl ether and of various solutions in this liquid of triphenylmethane and phenanthrene were determined with Altschul's apparatus, and the conclusions arrived at are—(1) the increase of the critical pressure is proportional to the concentration of the solution; (2) the relative lowering of vapour pressure or raising of boiling-point is zero near the critical conditions; (3) the critical portion of the limiting curve for any solution can be represented by $\pi = \pi_0 + A(\vartheta - \vartheta_0)$, where ϑ denotes the temperature of disappearance or reappearance of the liquid meniscus at pressure π; (4) the constant A = (molecular raising of critical pressure)/(molecular raising of critical temperature); (5) solutions of but slightly volatile substances belong to that group of binary mixtures in which retrograde condensation of the *first* kind occurs both at constant temperature and constant pressure. The influence of gravity on the limiting curve is also discussed. R. E. B.

1470. *Heterogeneous Equilibrium under Variable Pressures.* **E. Briner.** (Comptes Rendus, 142. pp. 1214–1216, May 28, and pp. 1416–1418, June 18, 1906.)—The author has studied the effect of variation of pressure on the equilibrium existing when liquid or solid bodies are formed from a mixture of two gases, the latter being derived from a substance which at ordinary temperatures has a dissociation pressure greater than that of the atmosphere. The three systems investigated are $HCl + PH_3$, $CO_2 + 2NH_3$, and $NH_3 + H_2S$. At the lowest pressures compatible with the presence of a solid body the observed dissociation pressure is found to agree well with that calculated from the formulæ—

$$p_1 = n\pi/(n + m), \quad p_2 = m\pi/(m + n), \quad \text{and } K = n^n m^m \pi^{n+m}/(n + m)^{n+m},$$

where p_1 and p_2 are the partial pressures of the gases A and B, A_nB_m the chemical formula of the solid body formed, π the dissociation pressure, and K a constant. W. H. Si.

1471. *Molecular Aggregation of Liquefied Gases.* **M. A. Hunter.** (Journ. Phys. Chem. 10. pp. 330–360, May, 1906. Part of Thesis, University of London.)—The author shows that (1) oxygen and ethane retain the same molecular complexity in the gaseous and liquid states, as also do methane and ethylene; (2) the presence of ethylene in oxygen and of ethane in methane produces an association of the molecules of the solvent: in the former case 3 molecules of oxygen, in the latter 2 molecules of methane associate to produce a single molecule of the respective gases; (3) ethane is soluble in liquid oxygen up to 15 per cent.; (4) ethane in liquid methane up to 10 per cent.; (5) ethylene in liquid oxygen to 1·9 per cent.; (6) all the other commoner gases are not soluble in liquid oxygen or methane even to the extent of 1 per cent. The author has also determined the vapour pressures of methane, ethylene, nitrogen monoxide, and acetylene. It is further shown that ozone forms a constant boiling mixture with oxygen (a minimum point) at a temperature of about 89·7° abs., the mixture containing from 4–5 per cent. of ozone. A. F.

1472. *Solution of Platinum by Sulphuric Acid.* **L. Quennessen.** (Comptes Rendus, 142. pp. 1341–1343, June 11, 1906. Chem. News, 93. p. 271, June 15, 1906.)—The author studied the solvent action of sulphuric acid, free from nitrous or nitric acids, upon pure and commercial Pt, at a temperature of 390° to 400°, both *in vacuo* and in the presence of oxygen. The results of the various experiments show that with commercial Pt, *in vacuo*, 0·001 gm. is dissolved per hour for every sq. dm. of surface exposed, while in oxygen 0·124 gm. is dissolved per sq. dm./hour, and oxygen is absorbed during the solution. On the other hand, 0·0227 gm. per sq. dm./hour in oxygen, and 0·0006 gm. *in vacuo*, is dissolved when pure Pt is employed. When sulphuric acid containing an excess of the anhydride (2 per cent.) is used, the amount dissolved is 0·0265 gm. per sq. dm./hour, and sulphurous acid is detected on opening the sealed tubes in which the heating is effected. The author concludes that the sulphur trioxide furnished the oxygen necessary for the solution of the platinum. [See also Abstract No. 425 (1906).] F. J. B.

1473. *Copper-Cadmium Alloys.* **R. Sahmen.** (Zeitschr. Anorg. Chem. 49. 3. pp. 301–310, May 31, 1906. Metallog. Communication from the Inst. f. anorg. Chem. d. Univ., Göttingen.)—The temperature-concentration diagram found by the author for these alloys is somewhat complicated, and must be studied with reference to the diagram itself and the thermal data contained in the paper. The general results are summarised as follows: Cu and Cd form only two compounds, whose composition corresponds, at all events closely, to the formulæ Cu_2Cd and Cu_2Cd_3. From Cu-Cd fusions containing from 0 to 42 atomic per cent. Cd, Cu crystallises between 1,084° and 552° C. At 552° the Cu reacts with the fluid, forming a compound which takes the form of long needles, probably of the composition Cu_2Cd. The rest of the fluid crystallises as a eutectic at 542°, but the reaction between the primary Cu and the fluid is never complete, and cannot be completed even by maintaining the alloy at a temperature between 552° and 542° for several hours. From fusions containing 42 to 45·4 per cent. Cd the compound just mentioned is formed by primary crystallisation, while the fluid containing 45·4 per cent. Cd crystallises at 542° as a eutectic. Fusions containing from 45·4 to 60 atomic per cent. Cd deposit crystals of a solid solution of the compounds Cu_2Cd_3 and Cu_2Cd, and those containing from 60 to 97·97 per cent. Cd deposit a solid solution of Cu_2Cd_3 and Cd. The fluid containing 97·97 per cent. Cd crystallises at 341° as a eutectic. Fusions containing from 97·95 to 100 per cent. Cd deposit crystals of Cd at temperatures from 314° to 321·7°. The paper is illustrated with one diagram and four photomicrographs. W. Ros.

1474. *Zinc-Antimony Alloys.* **S. F. Żemczužnyj.** (Zeitschr. Anorg. Chem. 49. 4. pp. 384–399, June 16, 1906. Laborat. f. allgem. Chemie d. Polytechn. Inst., St. Petersburg. From the Russian.)—Describes the cooling curves and microstructure of these alloys, a complete temperature-concentration diagram being given; the author arrives at the conclusion that the only compounds formed are Zn_3Sb_2 and ZnSb. Corresponding to the former there is a well-defined maximum in the freezing-point curve, but the latter is not represented by a maximum on this curve but only by a critical point. Alloys containing from 40 to 60 atomic per cent. Sb when cooled without inoculation deposit crystals of Zn_3Sb_2, which exist in a labile state in the presence of the excess of Sb; at a lower temperature these crystals react with the surrounding Sb, producing the compound ZnSb, the reaction being accompanied by a marked evolution of heat which produces a sudden rise in the cooling curve, these rises sometimes amounting to 80° C.; alloys in which this reaction has taken place show, on careful heating, a melting-point which differs markedly from the freezing-point. By inoculating the cooling alloy with crystals of ZnSb before crystallisation has begun the compound ZnSb can be caused to crystallise directly from the fusion, and in that case the evolution of heat at a lower temperature is suppressed. The freezing-point curve for this region thus takes a different form, according to the use or non-use of the process of inoculation, the diagram obtained by the one method being very similar to that obtained by Roland-Gosselin, while that resulting from the other method resembles the diagram of Mönkemeyer. The author further describes a change, accompanied by evolution of heat, undergone by the compound Zn_3Sb_2 on further cooling below the eutectic arrest-point in the alloys containing from about 4·7 to 40 atomic per cent. Sb. On the other hand, the author's cooling curves of pure Zn show no arrest-point corresponding to the change in electrical conductivity described by le Chatelier at 360°. W. Ros.

1475. *Effect of Arsenic on Brass.* **E. S. Sperry.** (Mech. Eng. 17. pp. 763–764, June 2, 1906. From the Brass World.)—The author investigated the effects of additions of arsenic up to 0·5 per cent. upon the properties of Muntz metal (60 per cent. Cu, 40 per cent. Zn). The presence of As increased the fluidity and resulted in the production of sharper and cleaner castings than are obtained without it. Up to 0·02 per cent. it improved the ductility, the brass standing more reduction in rolling, between annealings, than is possible in its absence. This is thought to be due to the reducing action of As on copper oxide. Higher percentages of As cause brittleness—the brass cracking in the rolls. F. R.

1476. *Microstructure of Brass.* **O. F. Hudson.** (Soc. Chem. Ind., Journ. 25. pp. 503–504; Discussion, pp. 504–505, June 15, 1906. Paper read before the Birmingham Section, Feb. 15, 1906.)—Discusses the structure of the alloys containing upwards of 50 per cent. Cu, in the light of Shepherd's results [see Abstract No. 2774 (1904)]. In the *discussion*, **W. Rosenhain** pointed out that the twinning mentioned by the author (of the *a* crystals—*i.e.*, those found in brass containing over 71 per cent. Cu) was primarily due to straining, as distinguished from annealing after strain. In reply to **H. Silvester**, the **Author** said that burnt brass was characterised by having a coarse structure, and frequently also by the presence of small holes, in appearance like bubbles of gas. F. R.

1477. *Silver and Silver Sulphide.* **K. Friedrich** and **A. Leroux.** (Metallurgie, 3. pp. 361–371, June 8, 1906. Communication from the Metallog. and Metallurg. Laborat. d. kgl. Bergakademie, Freiburg.)—The authors' determinations show that the diagram for the system silver-silver sulphide consists of three horizontal lines, the topmost of which, at 906° C., ends at about 90 per cent. Ag_2S, and is met at about 11 to 15 per cent. Ag_2S by a short curve starting from the solidification of pure Ag at 962°. It is considered that a separation into liquid layers takes place, and this is supported by the examination of the samples. The second line, at 806°, appears with about 15 per cent. Ag_2S and upwards. The third, at 175°, corresponds to a change of the silver sulphide. Silver filaments do not necessarily grow from solid Ag_2S in the presence of hydrogen gas; and the first essential to their production from molten Ag_2S is the presence of metallic silver. It is probable that there is a connection between the 175° point and the growth of the filaments. Ag_2S is decomposed by the action of light, with liberation of sulphur, which combines with free silver on the surface of a section of a sample from this series, giving rise to magnificent colour effects; these are illustrated in colours in the paper. In this way 0·01 per cent. sulphur in silver can be detected at a low magnification. Selenide and telluride of silver do not behave similarly. F. R.

1478. *Lead and Silver.* **K. Friedrich.** (Metallurgie, 3. pp. 396–406, June 22, 1906. Communication from the Metallog. and Metallurg. Laborat. der kgl. Bergakademie, Freiburg.)—The freezing-point curves determined by the author for Pb-Ag alloys do not differ materially from those given by Heycock and Neville, and are practically identical whether taken in contact with air or in an atmosphere of hydrogen. He places the eutectic temperature at 304° C., and composition at 2·5 per cent. Ag. The eutectic is found with from exceedingly little silver to over 99 per cent., this being supported by microstructure. The enrichment in silver upon which the Pattinson process depends is shown to be independent of the presence of iron—suggested by Bock as essential—as it occurs equally well in porcelain vessels. With from 0 to 2 per cent. Ag the cooling curves were the same at 5 atmos. pressure as at ordinary pressure. The Pb-Ag alloys exhibit no special tendency to liquate. F. R.

1479. *Bringing Copper to "Tough Pitch" by Means of Silicon and Silicides.* **F. Gloger.** (Metallurgie, 3. pp. 253–256, April 22, 1906. Communication from the Inst. f. Metallhüttenw. and Elektrometall. an der kgl. techn. Hochschule, Aachen.)—These experiments deal with the large stage of copper-refining, *i.e.*, getting the metal to "tough pitch" when over-poled, or, in other words, the elimination of the dissolved oxygen. Silicon copper 35 to 55 per cent. does not bring about the desired result, or only very incompletely. Silicon manganese, on the other hand, acts well—

$$4Cu_2O + Mn_2Si = 2MnO . SiO_2 + 8Cu.$$

The author thinks that for reverberatory practice Mn_2Si offers considerable advantages, the reaction only taking a few minutes. Experience and skill are, however, required to perform the operation. The method yields a very dense copper, which is often not the case in poling, owing to the distillation products of the wood employed—a point of considerable importance if the Cu is to be rolled. Traces of Mn and Si in the finished copper are advantageous for certain purposes. O. J. S.

1480. *Copper Steels.* **P. Breuil.** (Comptes Rendus, 142. pp. 1421–1424, June 18, 1906.)—Two series of steels were studied: A, with 0·150 to 0·173 per cent. carbon, and 0 to 32 per cent. Cu; B, with 0·282 to 0·412 per cent. carbon, and 0 to 32 per cent. Cu. There appeared to be practically no liquation except in the highest copper steel of series B, which showed the following percentages of copper: At centre of head, 34·2; at surface, 21·2; at centre near bottom, 74·8; at surface, 24·4. With over 4 per cent. Cu the steels could not be rolled. The Brinell hardness number increases with Cu up to 16 per cent. in A and 8 in B. The critical temperatures in cooling are given. In the two highest copper (16 and 32 per cent.) alloys in A, and the three highest (8, 16, and 32 per cent.) in B, there was a pause at 1,040° C. corresponding to the fusion [? solidification] of copper, or a copper-rich alloy. Increasing Cu in series A lengthens Ar_1 and lowers Ar_3; in series B it lengthens and lowers Ar_1. The evolution of heat at 975°–980° for all the samples appears to correspond to the separation of cementite. Ar_3 falls with increasing Cu. All of the steels are magnetic in the cold. F. R.

1481. *Production of Iron Silicides in the Electric Furnace.* **B. L. Vanzetti.** (Zeitschr. Elektrochem. 12. p. 343, May 4, 1906. Abstract from Soc. Chim. di Milano, Dec. 2, 1905.)—A mixture of CaO, coal, and SiO_2, melted at 3,000° in an electric furnace lined with MgO, gave pieces of ferro-silicium of hardness 7 and sp. gr. 6, containing 66–67 per cent. Fe and 33–34 per cent. Si, corresponding to the formula FeSi. The metal is homogeneous in fracture and non-magnetic. At higher temperatures and with longer heating carbo-silicides are obtained, and finally carborundum. L. H. W.

1482. *Vanadium as a Steel-making Element.* **J. K. Smith.** (Soc. Chem. Ind., Journ. 25. pp. 291–294; Discussion, pp. 294–295, April 16, 1906. Paper read before the Liverpool Section, March 14, 1906.)—The remarks chiefly concern chrome-vanadium steels, as dealt with in Abstracts Nos. 405B and 1640B (1905). Vanadium steels will not replace carbon steels where these are giving complete satisfaction. Four types of Cr-V steels are now made—for forging, torsional resistance, spring-making, and case-hardening respectively. Results of some tests of Ni-V steels are given—the static strength being high, but resistance to repeated bending moderate. A rough method of estimating vanadium in steel is given. In reply to several speakers in the *discussion* the **Author** compared some of the mineral sources of vanadium, and pointed out that any arsenic or phosphorus possibly present in ferro-vanadium would be insignificant in the steel, as vanadium is used in such small quantities, as, *e.g.*, 0·2 per cent. in the spring steel and slightly over 0·1 per cent. in the case-hardening steel. Nearly 30 per cent. of the vanadium added may be carried away in the slag. F. R.

1483. *Internal Structure of Hardened and Tempered Steel.* **E. Heyn** and **O. Bauer.** (Königl. Materialprüfungsamt, Mitt. 24. 2. pp. 29–59, 1906.)—Describes experiments on the hardening and tempering of a tool-steel of eutectoid composition by means of quenching, followed by subsequent tempering under definite conditions, and also by quenching in various liquids at specified temperatures. In the first series small pieces of the steel were first hardened by quenching in cold water from a temperature of 900° C., followed by reheating for periods varying from a few minutes up to 3 hours, at temperatures ranging from 100° to 600°. The effect of such treatment upon the hardness, chemical composition, and solubilities in dilute acids of such steels is investigated and the results correlated with those of Barus and Strouhal, le Chatelier, and others, special attention being given to the amount of "free carbon," "hardening carbon," and "cement carbon" found in the various specimens, the microstructure and surface colouration produced by various etching reagents being also studied. For details the reader must refer to the paper which is fully illustrated with diagrams and photographs. The authors summarise their conclusions as follows:—(1) The transition from martensite to pearlite through tempering at successively higher temperatures is not continuous but passes through a definite and well-marked intermediate stage for which the name osmondite is proposed. Of all the transition stages between martensite and pearlite, osmondite shows the highest solubility in dilute sulphuric acid, the solubility decreasing in the direction both of pearlite and martensite. Osmondite corresponds to a tempering temperature of 400°. The transition stages between martensite and osmondite should, it is proposed, retain the generic name troostite, and those from osmondite to pearlite the generic name sorbite. (2) When dissolved in 10 per cent. sulphuric acid under exclusion of air, the troostites leave no carbide residue but do leave "free carbon." Carbide residues only begin with the sorbites; osmondite forms the limit between the two, and this constituent yields the largest amount of "free carbon." (3) The colouration of tempered steels when treated with alcoholic acid, as also the colouration of troostites and of osmondite, arises from a film of free carbon deposited upon the surface: this colouration is accordingly deepest in osmondite. (4) All forms of quenching are equivalent to an ideal undercooling of the steel with consequent complete conversion into martensite, followed by a more or less marked tempering effect whose intensity depends upon the rate of cooling used. This consideration explains the occurrence of troostites and of osmondite in hardened steels. W. Ros.

1484. *Temperature-concentration Diagram of Iron and Sulphur.* **W. Treitschke** and **G. Tammann.** (Zeitschr. Anorg. Chem. 49. 3. pp. 320–335, May 31, 1906. Metallog. Communication from the Inst. f. anorg. Chemie d. Univ., Göttingen.)—Describes a study of the cooling curves and microstructure of the iron-iron sulphide series; the temperature concentration diagram is characterised by the absence of any compounds lying between Fe and FeS, and also by the fact that Fe and FeS are not completely miscible at the melting-point of iron; the well-known transformations of iron as well as the transformation of FeS at 130° C., discovered by le Chatelier, appear on the diagram. Owing to the presence of two liquid phases the cooling curves become complicated, and the authors ascribe a further complication to the presence in the case of the alloys richer in sulphur, of an oxide which is capable of forming a constituent whose microscopic appearance resembles that of a eutectic. For details of these observations, and of the diagram, the reader must refer to the original paper. The authors also deal with the causes of the brittleness of iron containing sulphur, both in the cold and at a red heat, in the light of the information gained from the diagram, and consider that the diagram readily accounts for the observed facts. The mechanical effects of the increase of volume which accompanies the transformation of FeS at 130° are also discussed, the authors pointing out that the pressure required to suppress the transformation either partly or entirely lies within the limits of elasticity of higher carbon and nickel steels. W. Ros.

1485. *Cast Iron in the Foundry.* **P. Longmuir.** (Mech. Eng. 17. pp. 770–772, June 2, 1906. Abstract of paper read before the West of Scotland Iron and Steel Inst.)—The author discusses the effects of composition, carbon condition, and methods of annealing, upon the properties of cast iron. A grey iron as cast gave 14·1 tons per sq. in. tensile strength; annealed at 850° C. for 48 hours the strength was 7·2 tons per sq. in.; a piece of the same iron, quenched from 940° C., broke with 8 tons per sq. in.—the weakness being due to the development of water cracks. Some differences between American and British malleable castings are pointed out. In the former graphite is usually high, very little removal of carbon being attempted; in the latter both graphite and combined carbon are low. It is possible to produce an iron of the former type by a comparatively brief annealing at a high temperature—very little short of the melting-point. Ledebur and Royston have investigated this question, and the author obtained 21·4 tons per sq. in. tensile strength, with no elongation, by annealing for 4 hours above 1,000° C., a cast iron of 12·9 tons per sq. in. original strength, as compared with 45·4 (? 25·4) tons per sq. in., with 2·1 per cent. elongation by annealing at 800° to 900° C. He finds that in American malleable castings sulphur averages 0·55, and in British, 0·8 per cent. The latter are better in tests, and the long annealing usual in British practice alters the dangerous network of sulphide to the relatively harmless globular form. F. R.

1486. *Sulphur in Iron.* **R. Baumann.** (Metallurgie, 3. pp. 416–417, June 22, 1906.)—Describes a simple method for detecting the distribution of sulphide impurities in sections of iron or steel. A piece of ordinary photographic silver bromide paper is soaked in dilute sulphuric acid, allowed to drain superficially, and then squeegeed against the surface of the section, which has previously been ground flat and cleaned from all greasy matter. The evolution of H_2S at the points rich in sulphur, produces a blackening of the paper, which is subsequently fixed and washed in the usual way. The paper is illustrated by a number of nature prints produced in this way, and the author considers that they compare favourably as regards sharpness with those produced upon silver-foil. W. Ros.

1487. *Mutual Relationships of the Different Modifications of Carbon.* **R. Schenck** and **W. Heller.** (Ber. Deut. Chem. Gesell. 38. pp. 2139–2143, 1905.)—When a mixture of carbon and ferrous oxide is heated the highest pressure of gaseous oxides is produced with amorphous charcoal, and the lowest with graphite; powdered diamond gives intermediate values, but the values approximate to those for amorphous sugar-charcoal. The powdered carbon obtained by decomposing CO gives values identical with those for graphite [see Abstract No. 795 (1906)]. **R. Schenck.** (Zeitschr. Elektrochem. 12. pp. 218–220, March 16, 1906.)—In reply to a criticism by Baur, Schenck points out that the equilibrium pressure in the system $FeO + CO = Fe + CO_2$ was determined with CO which was quite free from air, and that the final values were taken only after the iron (precipitated on pumice) had been completely converted into ferrous oxide by heating again and again with CO until steady results were obtained. The differences between these observed pressures and those deduced by combining the observations of Baur and of Glaessner, may perhaps be attributed in part to inaccuracies in the measurements made by the latter authors, but the main discrepancy is more probably due to their use of wood charcoal in place of graphite. T. M. L.

1488. *Combination of a Solvent with the Ions.* **J. L. R. Morgan** and **C. W. Kanolt.** (Amer. Chem. Soc., Journ. 28. pp. 572–588, May, 1906.)—

When a solution of silver nitrate in a mixture of ethyl alcohol and water is electrolysed, changes in the composition of the solvent about the poles indicate that water is carried by the silver ion. The results do not indicate the presence of more than 1 mol. of water with each silver ion. This conclusion can also be drawn from the work of de Bruyn and Jungius [see Abstracts Nos. 332 and 365 (1904)] with silver nitrate dissolved in aqueous methyl alcohol. When silver and calcium nitrates are dissolved together in water, the changes in the composition of the solvent upon electrolysis are so small that they may be due to the hydration of the silver alone, so that there is no evidence of the hydration of the calcium ions. By the electrolysis of a solution of silver nitrate in a mixture of pyridine and water, it is found that a large proportion of the pyridine present is combined with the silver ions.

T. H. P.

1489. *Gas Cells at High Temperatures.* **F. Haber.** (Zeitschr. Elektrochem. 12. pp. 415–416, June 15, 1906. Paper read before the Dresdener Hauptversamml. der Deutsch. Bunsen-Gesell.)—The author has measured the e.m.f. at temperatures of 400–500°, of cells formed by hydrogen of different concentration, of oxygen of different concentration, and of hydrogen and oxygen. Glass formed the electrolyte. The following values were obtained :—

Cell.	Temp.	Volt found.	Volt calculated.	Electrode material.
H_2 100 per cent. — H_2 4·4 per cent.	470°	0·093	0·099	Pt
H_2 100 „ — H_2 4·15 „	472	0·101	0·101	Au
H_2 100 „ — H_2 2·1 „	560	0·136	0·138	Pt
H_2 100 „ — H_2 4·15 „	570	0·115	0·116	Au
O_2 94 „ — O_2 1·81 „	460	0·059	0·062	Pt
O_2 94 „ — O_2 1·81 „	475	0·058	0·063	Au
O_2 94 „ — O_2 1·9 „	560	0·069	0·069	Pt
O_2 94 „ — O_2 1·81 „	575	0·075	0·072	Au

With respect to the hydrogen-oxygen cell, good agreement was found between the theoretical and experimental numbers. In harmony with theory it was found that the e.m.f. increased with the drying of the hydrogen. Experiments were also carried out at temperatures up to 1,100°, using porcelain as electrolyte, and good agreement again found.

A. F.

1490. *Behaviour of the Nickel-oxide Electrode of Junguer-Edison Accumulators.* **J. Zedner.** (Zeitschr. Elektrochem. 12. pp. 463–473, July 6, 1906. From the Inst. f. phys. Chem. d. Univ., Göttingen. Engineering, 82. p. 89, July 20, 1906.)—The former experiments of the author [Abstract No. 433 (1906)] had left the amount of hydration of the oxide Ni_2O_3 uncertain. By comparing, after the method of Pareau, the water tension of his oxide with that of sulphuric acid of graded concentrations, the author finds that the hydrate $Ni_2O_3 \cdot 3H_2O$ is stable when the vapour tension is below 3 mm. Hg, and the hydrate $Ni_2O_3 \cdot 6H_2O$ stable above that tension. There is no intermediate hydrate. In the caustic potash of the charged accumulator the former nickelihydrate, as a rule written $Ni(OH)_3$, seems to exist. The potential of the nickel oxide electrode against a hydrogen electrode falls when the concentration of the potash increases ; the temperature-coefficient is negative, 0·0007 volt per 1° C. During the discharge of the electrode, the potential twice remains constant for some time, as is well known. The first step corresponds to the reduction of nickelihydrate to nickelohydrate

$Ni(OH)_2$; the second step is not connected with the formation of some other oxide, as had been suggested, but with the discharge of occluded oxygen. Oxygen is liberated at the nickel oxide electrode during the charge, and more oxygen is occluded, rather by the graphite mixed with the nickel oxide than by the oxide itself. The amount of occluded oxygen was determined; a specially prepared Jungner electrode, not containing any graphite, did not mark the second step, but an electrolytically prepared nickel electrode, also free of carbon, did indicate it. The influence of the oxygen is, however, indirectly confirmed by the calculation of the e.m.f. after Helmholtz, and by experiments in which the author quickly alternated discharge and charge. On the first step of the curve the potential rises slowly, because the rise depends upon the necessarily slow diffusion of the alkali from the pores back into the cell; on the second step the rise is abrupt, but it depends upon reoxidation of the oxide. The experiments were carried out on the instigation of Dolezalek and with the aid of the Kölner Akkumulatorenwerke G. Hagen. H. B.

1491. *Action of Depolarisers.* I. **F. Weigert.** (Zeitschr. Elektrochem. 12. pp. 377–382, May 18, 1906. From the Phys.-chem. Inst. d. Univ., Berlin.)—With the aid of the arrangement used by Nernst and Merriam for studying the residual current [see Abstract No. 2301 (1905)], the author investigates the action of depolarisers which do not react with infinite velocity. The excentrically rotating platinum point is kathodically polarised with hydrogen, and the depolariser added to the liquid. When the potential-fall ϵ at the platinum point is plotted as abscissa against the current intensity i, the residual-current intensity rises slowly first, then steeply in an S-curve which reaches the same i-level for all the ϵ; afterwards hydrogen is evolved and the i-curve becomes perpendicular. The steep portion of the S-curve corresponds to Müller's depolarisation potential, and does not mark any particular reaction. Potassium permanganate and the halogens give theoretical S-curves; the other depolarisers, IO_3', BrO_3', O_2, Cr_2O_7, S_2O_8'', H_2O_2, give better results when the excentric platinum point is replaced by a concentrically rotating ring. With iodic acid the S-curve rises first, drops then suddenly at —0·56 volt, while iodine is deposited on the electrode, and rises again steeply while iodine flakes peel off again. The results cannot directly be applied to anodic depolarisation; the iodine ion gave in this case two completely separated residual-current curves. H. B.

1492. *Electrolytic Separation of Tin from Nickel and Cobalt and of Copper from Antimony.* **N. A. Puschin** and **R. M. Trechzinsky.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 37. pp. 828–833, 1905.)—Contrary to what would be expected from theoretical considerations, Sn, Cd, and Zn can be precipitated electrolytically from acid, and Co and Ni from neutral, solutions. The authors have hence devised the following method for separating Sn from Ni or Co. To a neutral solution of the two metals, about 8 gm. of ammonium oxalate are added per gm. of tin present, and about 8 gm. of oxalic acid per gm. of nickel (or cobalt), and 15–20 gm. per gm. of tin. Through the liquid containing the precipitated nickel (or cobalt) oxalate a current is kept passing at a voltage not less than 2·2 until the whole of the tin is deposited, each gm. of tin requiring 6–7 amp.-hours. The liquid is then heated with concentrated ammonia solution to dissolve the nickel (or cobalt) oxalate and the Ni (or Co) determined by Oettel's method [Zeitschr. Elektrochem. 1. pp. 192–194 (1894–1895)]. On dissolving an alloy of Cu and Sb in nitric acid, the latter metal is precipitated as metantimonic acid, and if the liquid is diluted with water and submitted to the action of the current, only the copper is deposited at less than 2·05 volts. When all the copper has been removed, the metantimonic acid is dissolved in sodium sulphite, sodium hydroxide being then added and the antimony estimated by Classen's method. T. H. P.

1493. *Validity of Faraday's Law for Metals with Ions of Several Valencies.* **R. Abegg** [experimental work by **J. Shukoff**]. (Zeitschr. Elektrochem. 12. pp. 457–459, July 6, 1906.)—For metals which form ions of several valencies n_o and n_i, Nernst's theory demands a definite ratio of the concentrations of those ions (*o*) and (*i*), since the electrode can only have one potential with regard to the solution [see Abstract No. 619 (1905)]. Starting from this point of view, Abegg deduces that when the absolute concentration of the ions is diminishing, ions of the lower valency should by preference be dissolved or deposited. Thus theoretically the valency of such a metal should, on electrolytic deposition, never appear to be strictly an integer. For mercury, where $n_i = n_o = 2$, Abel and Ogg have shown that the ions, when in equilibrium with the metal, are in the ratio $(o):(i) = 120$. The experiments now made by Shukoff with solutions of mercury nitrate in an apparatus resembling Wright's electrolytic electricity meter, confirm that 120 in 121 parts of mercury are deposited as *o*-ion, and 1 part in 121 as *i*-ion, so that only 99·6 per cent. of the amount is deposited (or dissolved) which would correspond to the full *o*-valency. H. B.

1494. *Electrolytic Formation of Hyposulphites.* **M. G. Levi** and **M. Voghera.** (Accad. Lincei, Atti, 15. pp. 322–328, March 18, and pp. 363–369, April 1, 1906.)—After showing that their previous conclusions [see Abstract No. 205 (1906)] are not invalidated by the formation of any tetrathionate in addition to the hyposulphite, the authors continued the systematic study of the different factors which may influence the electro-chemical formation of hyposulphite. Much better yields were obtained with platinised Pt as anode than with smooth Pt, Ni, Fe, Pb, or PbO_2. Dilution of the sulphite reduces the yield of hyposulphite, as does the addition of caustic soda to the anodic liquid. The authors find that the presence of polysulphides in the kathodic space increases the yield of hyposulphite obtained by the electrolysis of sulphite. The electrolysis is also favoured by a current of small density and the presence of a slight excess of alkaline carbonate in the concentrated solution of alkali sulphite. No certain indication of the presence of a characteristic anodic potential could be detected. D. H. J.

1495. *Electrolytic Decomposition of Dicarboxylic Organic Acids. Adipic Acid.* **B. L. Vanzetti.** (Accad. Lincei, Atti, 15. pp. 574–578, May 20, 1906.)—The mean composition of the gases from the electrolytic cell (when a 27 per cent. solution of dipotassium adipate is electrolysed by a current of 0·6 amp. density) is as follows: CO_2, 25 per cent.; O, 12 per cent.; unsaturated hydrocarbon, C_4H_8, 1·5 per cent; CO, 1·5 per cent.; H, 60 per cent.; the liquid remaining in the cell contains a reducing substance of aldehydic character. The electrolysis is thus seen to be complicated by anodic oxidation. The yield of unsaturated hydrocarbon increases with the concentration of the electrolyte and the current density. D. H. J.

1496. *Direct Synthesis of Nitric Acid and Nitrates by the Silent Discharge at Ordinary Temperatures.* **Berthelot.** (Comptes Rendus, 142. pp. 1867–1879, June 18, 1906. Erratum, p. 1588, June 25, 1906.)—The author treats air or mixtures of oxygen and nitrogen in different proportions in an ozoniser, in the presence of water or of diluted caustic potash solution, at ordinary temperatures, which finally might rise to 80° C. Nitric acid or nitrate are produced in all cases, and only traces of nitrous acid and ammonia. Passing 0·5 litre of air per hour through his ozoniser at 10° C., he obtains 0·0192 gm. of HNO_3 per hour; the reaction is not accelerated when caustic potash serves as absorbent. In closed vessels all the oxygen is finally consumed; about half of the total acid produced is formed during the first 3½ hours; an excess of nitrogen seems to retard the reaction. Insertion of a Leyden jar into the circuit of the induction apparatus had no distinct influence. Current measurements are not mentioned; the gas pressures were determined. According to the author, the fundamental reaction in this apparatus is exothermic, $N_2 + O_5 + H_2O + \text{aq.} = 2NO_3H$ diluted $= +\ 28{\cdot}6$ cal., while the formation of NO by the spark or arc would be endothermic: $2N + 2O = 2NO = -\ 43{\cdot}2$ cal. H. B.

1497. *Ozone Formation by the Silent Discharge; Influence of the Vessel Substance and of Light.* **F. Russ.** (Zeitschr. Elektrochem. 12. pp. 409–412, June 15, 1906. Technolog. Gewerbemuseum, Wien.)—In his experiments on the production of formaldehyde from CO and H by the silent discharge, Löb [see Abstract No. 1149 (1906)] had not observed any distinct change in the reactions when apparatus of uviol glass were used instead of ordinary glass. Regarding the formation of ozone, with Warburg and Nernst, as a photochemical process, the author constructed apparatus of equal dimensions of Thuringian Geräteglas and quartz glass; the latter gave only half the yield of ozone of the former. The apparatus is tubular, the tubes containing acidulated water; high-tension alternating currents are applied. A uviol glass apparatus of the same dimensions could not be obtained. When the experiments were, however, conducted first in the dark and then in the light of a mercury arc lamp, the ozone formation was always reduced by the light rays, by 6 per cent. in glass, by 23 in uviol glass, and by 44·5 in quartz glass. The oxygen experimented upon contained 3·6 per cent. of nitrogen, which may have influenced the results. H. B.

1498. *Oxidation of Nitrogen by Explosion.* **H. Danneel.** (Zeitschr. Elektrochem. 12. pp. 444–448, June 29, 1906.)—Muthmann and Hofer [see Abstract No. 1130 (1904)] have obtained results for the equilibrium-constant of the reaction $N_2 + O_2 = 2NO$, differing largely from the results of Nernst [see Abstract No. 3215 (1904)]. Häusser has recently obtained results which confirm Nernst's work [see Abstract No. 1505 (1906)]. In this paper the author takes Häusser's results and compares them with those of Nernst and of Muthmann and Hofer. Nernst's results give the following equation for the equilibrium-constant K: $\log K + 9424/T = 1{\cdot}07$, while Muthmann and Hofer's results give $\log K + 9424/T = 2{\cdot}47$; but it is shown that the results of Häusser are in close agreement with those of Nernst. In the latter part of the paper the method and cost of obtaining HNO_3 by explosion are discussed. A. W.

REFERENCES.

1499. *Relative Solubility of Difficultly Soluble Calcium and Barium Salts.* **H. W. Foote** and **G. A. Menge.** (Amer. Chem. Journ. 35. pp. 432–445, May, 1906. Contribution from the Sheffield Lab. of Yale Univ.)—The following are the results obtained by the authors. Relative solubility at room temperature of $CaCO_3/BaCO_3 = 1{\cdot}15$ and of $CaC_2O_4/BaC_2O_4 = 0{\cdot}22$. [See Kohlrausch, Zeitschr. Phys. Chem. 50. pp. 355–356, Dec. 20, 1904.] T. H. P.

1500. *Quantitative Relation between Molecular Conductivities.* **P. Blackman.** (Phil. Mag. 11. pp. 416–418, March, 1906.)—The author tabulates for a number of cases the loss of electrical conductivity on mixing an acid and a base. T. M. L.

1501. *Decomposition of Aqueous Copper Sulphate by Aluminium Alloys.* **H. Pécheux.** (Comptes Rendus, 142. pp. 575–577, March 5, 1906.)—The action of Mg–Al alloys on pure copper sulphate solution consists, in all cases, of a reduction of the water by the Mg and reduction of the copper sulphate by the Al. A polished surface of a Mg-Al alloy receives a solid, adherent deposit of copper which can be easily removed by means of a knife-blade. Alloys of all proportions of Sn and Al with filed surfaces cause decomposition of the water and copper sulphate, but the action soon ceases, the layer of Al which remains adhering to the surface of the alloy being in this case insoluble. [Compare Abstract No. 2109 (1905).] T. H. P.

1502. *Alloys for Cartridge Cases for Quick-firing Guns.* **L. Cubillo** and **A. P. Head.** (Inst. Mech. Engin., Proc. 4. pp. 791–828; Discussion and Communications, pp. 829–853, Oct.–Dec., 1905. Bull. Soc. d'Encouragement, 107. pp. 1145–1159, Aug., Sept., and Oct., 1905. Engineering, 80. pp. 567 and 569–575, Oct. 27, 1905.)—A cooling curve of the 67 per cent. Cu + 33 Zn alloy used is given, as this is taken as the eutectic, and the curve has been accurately observed by Cubillo. Photomicrographs show the structure at several stages in the drawing and annealing operations. F. R.

1503. *Course of Fusion Curve in Solid Solutions in Special Case.* **J. J. van Laar.** (Zeitschr. Phys. Chem. 55. pp. 435–441, May 18, 1906.)—The author discusses the results of Day and Allen on feldspars [see Abstract No. 1798 (1905)], and especially the relations of the two fusion curves. H. H. F. H.

1504. *Course of Melting-point Curves for Compounds Partially Dissociating in the Liquid Phase in Arbitrary Proportions.* **J. J. van Laar.** (Konink. Akad. Wetensch. Amsterdam, Versl. 14. pp. 711–726, March 7, 1906. Proc. 8. pp. 699–714, March 22, 1906.)—A detailed investigation of the course of the melting-point curve, first approximately and then in general terms. H. H. F. H.

1505. *Synthesis of Nitric Acid.* **F. Häusser.** (Zeitschr. Vereines Deutsch. Ing. 50. pp. 298–302, Feb. 24, 1906. Paper read before the Pfalz-Saarbrücker Bezirksverein, July 2, 1905.)—A possible method of obtaining nitric acid on a large scale from the air is discussed. The reaction—

$$N_2 + O_2 \overset{\longrightarrow}{\underset{\longleftarrow}{=}} 2NO$$

is reversible, taking place from left to right when the temperature is high and from right to left when the temperature is low. By compression and explosion the temperature may be raised high enough for the formation of nitric oxide. This with excess of oxygen would give the peroxide, which with more oxygen and warm water gives nitric acid. The author intends to test his method. A. W.

1506. *Dissociation of the Alkali Carbonates.* **P. Lebeau.** (Annal. Chim. Phys. 6. pp. 422–432, Nov., 1905.)—Of the carbonates of the five alkali metals, only that of caesium is appreciably volatile, and the dissociation of this carbonate is independent of any action on siliceous matter. The other four carbonates also dissociate and completely volatilise when heated in a platinum boat in a vacuum, the silica of the porcelain tube being also acted upon. T. H. P.

1507. *Electrolysis of the Alkali Salts of Organic Acids.* IV. **J. Petersen.** (Zeitschr. Elektrochem. 12. pp. 141–145, March 2, 1906. Elektrochem. Laborat. der. polytechn. Lehranstalt, Kopenhagen.)—An account of the electrolysis of the potassium salts of ethyl, methyl, acetic acid, lauric acid, myristic acid, palmitic acid, stearic acid. [See also Abstract No. 1714 (1900).] D. H. J.

1508. *A Carbon Cell.* **A. de Geofroy.** (Écl. Électr. 46. pp. 415–420, March 17, 1906.)—A primary cell has been constructed with both electrodes of carbon in a solution of salt. One electrode must be above the other and exposed to the air. After standing a few days the e.m.f. is about 1/3 volt, the upper plate always being the positive pole. Experiments support the view that the lower carbon is oxidised and that the hydrogen liberated from the reaction at the upper pole is attacked by the oxygen of the air. W. W. H. G.

1509. *Electrolytic Winning of Lithium.* **O. Ruff** and **O. Johannsen.** (Zeitschr. Elektrochem. 12. pp. 186–188, March 9, 1906. From the anorg. and elektrochem. Laborat. d. techn. Hochschule, Dantzig.)—Lithium bromide with an addition of 10–15 per cent. lithium chloride is electrolysed with a carbon anode and an iron kathode with 10 volts and 100 amps. The current efficiency is 80 per cent. The metal obtained has a melting-point of 180° C. W. W. H. G.

1510. *Amphoteric Electrolytes.* **H. Lundén.** (Zeitschr. Phys. Chem. 54, pp. 532–568, Feb. 13, 1906. Phys. Inst. Stockholms Högskola, July, 1905.)—The author has determined the acid and basic dissociation constants for *o*-aminobenzoic acid, β-*i*-asparagin, and acetoxime at different temperatures, and criticises the theories of pseudo-acids and bases and of amphoteric electrolytes put forward by Hantzsch, Walker, and others. [See Abstract No. 283 (1905).] A. F.

1511. *Alternate-current Electrolysis as shown by Oscillograph Records.* **W. R. Cooper.** (Faraday Soc., Trans. 1. pp. 313–318; Discussion, pp. 318–323, Feb., 1906. Elect. Engin. 36. pp. 625–628, Nov. 3, 1905. Abstract.)—The author starts by reviewing the existing literature on the subject and then discusses the subject mathematically, and deduces an approximate theoretical diagram assuming a sine curve for the applied pressure and constructing the curve for the current. He then explains the connections made in utilising the oscillograph, and gives numerous curves obtained with a current of periodicity 83 and at various e.m.f.'s, the electrolyte being dilute H_2SO_4, and the poles platinum wires. Further curves obtained with aluminium electrodes are given. J. L. F. V.

1512. *Electrolysis of Salts of ββ-dimethyl Glutaric Acid.* **J. Walker** and **J. K. Wood.** (Chem. Soc., Journ. 89. pp. 598–604, April, 1906.)—Sodium ethyl $\beta\beta'$-dimethyl glutarate when electrolysed in a 45 per cent. aqueous solution by a current of 3 amps. gives diethyl $\beta\beta\beta'\beta'$-tetramethyl suberate. Sodium $\beta\beta'$-dimethyl glutarate under similar conditions yields at the anode chiefly CO and CO_2. There is formed also a small quantity of a pentene, C_5H_{10}, which was proved to be unsymmetrical methyl ethyl ethylene; there is thus an undoubted fundamental rearrangement of the carbon nucleus, most easily conceived as a migration of a methyl group.

D. H. J.

1513. *Crystalline Structure of Electro-deposited Copper.* **A. K. Huntington.** (Faraday Soc., Trans. 1. pp. 324–325; Discussion, p. 325, Feb., 1906. Page's Weekly, 7. pp. 1037–1038, Nov. 10, 1905. Abstract.)—The author refers to an explanation previously given, and mentioned by Cowper-Coles in his notes on the rapid electro-deposition of copper [Abstract No. 231 (1906)], as to the reason why a spiral scratch or groove on a mandril causes copper deposited on it to part easily and form a long ribbon. His explanation is that the crystals form at right angles to the groove and that there is a want of continuity between the adjacent crystals, which results in a line of weakness being formed. He illustrates his explanation with several photomicrographs. J. L. F. V.

1514. *Concentration of Metalliferous Sulphides by Flotation.* **A. K. Huntington.** (Faraday Soc., Trans. 1. pp. 345–355; Discussion, pp. 355–361, Feb., 1906. Chem. News, 93. p. 9; Discussion, pp. 9–10, Jan. 5, 1906. Abstract.)—The author, after describing briefly the nature of ores from the Broken Hill mines, which are being treated in practice by the flotation process, points out that the gas which adheres to the metallic sulphides and causes them to float is CO_2. "Weathering" need not have taken place in the ore. Experiments on numerous minerals and mixtures of minerals are described. Further experiments were made with a view to investigating the electrostatic theory, and the author subsequently discusses and criticises Swinburne and Rudorf's surface-tension theory [see Abstract No. 995 (1906)]. The discussion was a joint one, on the author's and Swinburne and Rudorf's papers. J. L. F. V.

1515. *Transport of Liquid by the Electric Current.* **E. van der Ven.** (Archiv. Musée Teyler, 9. 4. pp. 573–604, 1905.)—In solutions of nickel sulphate, the transport takes place from the anode to the kathode, but in those of nickel nitrate or chloride in the opposite direction. The amount transported per unit of time is proportional to the current and inversely proportional to the weight of salt present per unit volume. [See also Abstracts Nos. 2364 (1904) and 650 (1906).] T. H. P.

1516. *Absolute Potential Differences.* **J. Billitzer.** (Zeitschr. Elektrochem. 12. pp. 281–282, April 13, 1906.)—In reply to criticisms by Goodwin and Sosman [see Abstract No. 1930 (1905)] and also by J. C. Blake, the author states that his critics have, in repeating his experiments, selected the method which he himself had called the worst, and not observed due caution. H. B.

1517. *Decomposition of Formaldehyde by the Silent Discharge.* **F. Russ.** (Zeitschr. Elektrochem. 12. pp. 412–413, June 15, 1906. Technolog. Gewerbemuseum, Wien.)—The reaction $CO + H_2 \rightleftarrows CH_2O$ is, according to Löb [see Abstract No. 1149 (1906)], reversible in the presence of water. The author shows, with the aid of a glass electrisator, lowered into an oil bath, that the reaction is also reversible in the absence of water at 150° C., and probably at lower temperatures likewise. H. B.

1518. *Formation of Electrolytic Chromium.* **O. Dony-Hénault.** (Zeitschr. Elektrochem. 12. pp. 329–330, April 27, 1906.)—Experiments made by the author and W. Gittens with solutions of chrome-alum confirm the results of Carveth and Curry. [See Abstract No. 1510 (1905).] T. H. P.

1519. *Higher Forms of Combination of Silver.* **G. A. Barbieri.** (Accad. Lincei, Atti, 15. pp. 500–504, May 6, 1906.)—The higher oxide of silver obtained electrolytically is not a true peroxide, as it does not in presence of acid reduce other compounds rich in oxygen, such as manganese dioxide and potassium permanganate. D. H. J.